Physical performance and 25-OH D vitamin. A cross-sectional study of pregnant and newly pregnant Swedish and Somali women

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Design. A cross-sectional study at the end of May in a Swedish town at latitude of 60° N.

Objective. To examine grip strength, upper leg performance and concentrations of 25-hydroxyvitamin D (25-OH D) in veiled Somali and unveiled Swedish pregnant or newly pregnant women.

Subjects. 123 women (58% Swedish) listed at an antenatal clinic.

Methods. Maximal grip strength (Newton, N) was tested. Upper leg performance was categorized as being able, or unable, to squat, stand on one leg, to stand up from a chair (sit to stand) and to lift the hip (Brandenburg’s sign). Social and anthropometric data were collected.

Blood samples for measuring plasma 25-OH D in nmol/L were drawn ten days before the physical tests. 25-OH D was also categorized as < 10 = undetectable, 10–24, 25–49, 50–74 and > 75 nmol/L.

Median values (ordinal data) and mean values (interval data) were calculated. Nonparametric statistics were used to test for significant differences in ability to perform physical tests across the 25-OH D categories. Undetectable values (< 10 nmol/L) were replaced with a 9 in the uni- and multivariate linear correlation statistics.

A final main effect model for grip strength (N) was calculated using stepwise linear regression for the independent variables country of birth, 25-OH D, age, height, weight, physical activity, lactation, parity and gestational age.

Results. 35% of the Somali women had < 10 nmol/L of 25-OH D, and altogether 90% had < 25 nmol/L 25-OH D. In contrast, 10% of Swedish women had < 25 nmol/L of 25-OH D, and 54% of them had < 50 nmol/L.


Grip strength (N) correlated to 25-OH D in total 0.68, (0.28, p=0.02 Swedish; 0.35 p=0.01 Somali).

Three-quarters (73%) of the Somali women were unable to squat, 29% were unable to stand on one leg, and 21% had a positive Trendelenburg’s sign, ns across 25 OH D categories.

Nearly all Swedish women could perform these tests.

Grip strength (N) was significantly associated with plasma 25-OH D (B 0.94, p=0.013) together with Somali birth (B –63.9, p<0.001), age (B 2.5, p=0.02) and height (B 1.7, p=0.01) in the final model.

Conclusion. The Somali women had undetectable or severely low 25-OH D concentrations and prominent muscular weakness in hands and upper legs where grip strength was strongly associated to the low 25-OH D concentrations.

Key words: vitamin D, 25-OH D, ultraviolet light, grip strength, clinical observation, physical performance, primary care, Somalia, women, pregnancy
Ultraviolet (UV) light promptly increases skin synthesis of large quantities of vitamin D3 and thus preventing UV light from reaching the skin will reduce this production. Through the heart of Scandinavia at the 60th parallel, the sun’s angle gives a vitamin D3 production limited to the summer half year. For six months the UV light is absorbed in the atmosphere. Thus, dark pigmented persons wearing veiled clothing and who live at high latitudes produce very little of vitamin D3 during most part of the year. Food like oily fish, milk, egg yolk and some mushrooms is a secondary source of vitamin D3.

In the skin, the UV-light transforms 7-dehydrocholesterol to Vitamin D3, which is hydroxylated to 25-hydroxyvitamin D (25-OH D) in the liver, and then transported by a vitamin D binding globulin to the muscle cells where it is activated to calcitriol. 25-OH D impacts on enzyme systems in muscle cells. Myopathy can therefore be a symptom of 25-OH D deficiency. Polymorphisms in the vitamin D receptor account for individual differences in muscular strength. Anabolic effects of 25-OH D embrace both increased volume and better contraction and relaxation of muscles, while 25-OH D deficiency causes atrophy and weakness. Supplements of vitamin D3 to elderly persons may improve their muscle strength and among younger people with 25-OH D deficiency < 25 nmol/L, supplements of vitamin D3 to elderly persons may improve their muscle strength.

Skin synthesis of vitamin D3 decreases with age. Focus for many studies have thus been elderly persons’ vitamin D status and lower extremity function. Little is known regarding hand strength or/and physical performance in pregnant women, or their 25-OH D status. One reason might be that pregnant and lactating women are often excluded from studies. However, gestational diabetes, pre-eclampsia and birth complications have tentatively been linked to vitamin D insufficiency in US studies. A historic case report commented on the waddling gait and weakness in patients with osteomalacia. Also the first author observed waddling gait among his female patients of foreign birth, especially those coming from Somalia (unpublished data). In Sweden, there are only few data regarding vitamin D status in the general population, or pregnant women, and no data on possible consequences of vitamin D deficiency. One recent Swedish study showed that pregnant Somali women often had severe vitamin D deficiency, but no clinical data were presented. Severe vitamin D deficiency might impair muscular strength also in younger women and interfere with i.e. child care.
Immigrant children have a higher frequency of unintentional injuries according to Scandinavian studies. These aspects were the wider rationale for a project to explore physical performance and 25-OH D in pregnant women with the focus on immigrant women, and dark-pigmented and veiled women in particular. An overall aim of the project was to improve function and lifestyle in all pregnant women and new mothers by providing adequate antenatal and primary health care to them. Here, the specific aims were to examine grip strength, physical performance of the lower limbs and plasma concentrations of 25-hydroxyvitamin D (25-OH D) in a group of pregnant women and new mothers with presumably lower (veiled women, Somali born) and higher (unveiled, Swedish born) concentrations of 25-OH D.

We hypothesized that grip strength and physical performance in upper legs would correlate to 25-OH D levels and that this would be more evident in the lower range of 25-OH D concentrations found among Somali women.

SUBJECTS AND METHODS

Recruitment procedure

This study was designed as a cross-sectional study and carried out in the setting of an antenatal clinic administered from a primary care center in a Swedish middle-sized industrial town at the 60th parallel. We chose a study period in late spring to reflect the effects of the dark season with little ultraviolet radiation that affects 25-OH D production, especially in dark-pigmented veiled persons. A retrospective design was chosen in order to minimize the seasonal effect on UV-light. This design needed women at a specific time of the year rather than women at a specific gestational age and enable us to complete the blood sampling and physical tests during a limited period of time. Therefore this study population included women in all trimesters as well as new mothers.

Sixty persons had to be included (30 Swedish; 30 Somali) to reach a 94% power and α error 0.05 according to a power calculation using data from an unpublished pilot study of 25-OH D in consecutive female patients (n =30 veiled; n=12 unveiled) having mean values of 25-OH D: 17 nmol/L (Std 13) and 35 nmol/L (Std 28), respectively. The power calculation was approved by the regional ethics committee Uppsala (D nr 2010/40), Sweden.

The study group was recruited among the Somali and Swedish women enlisted at the antenatal clinic at the beginning of May 2010 and 21 months (Somali) and 9 months (Swedish), retrospectively. A retrospective enlisting procedure was performed in order to reach statistical power. Therefore the initial study population should comprise roughly 75 Swedish and at least 50 Somali women.
Women < 18 years were excluded, as were women from other countries, or those who had severe mental or somatic disorders.

Clothing covering the arms, legs and head was considered concealing (veiled clothing).

Overview of sampling procedureREV2, comment 3

First, a list was provided by the antenatal clinic containing the names and parity of 118 Somali women (21 months backwards) and 309 Swedish women (9 months backwards). Country of birth was identified by a Somali assistant nurse and the head researcher using the criterion of surname and language. All the women were categorized as primi- or multi-para. The Swedish women were then randomized to match the Somali women by categorized parity.

Second, 309 Swedish and 118 Somali women were sent an information letter in Swedish. In addition, a Somali version of the letter was sent to the Somali women.

Third, the Somali women were contacted by phone by a Somali nurse assistant. She read the information aloud in Somali if the woman had limited literacy. Dates for blood sampling and the written consent were suggested to those who wanted to participate. The Swedish women were contacted by phone by one of the research doctors.

Fourth, altogether 140 women of 217 contacted came for the blood sampling and the written consent, (64.5% or 140/217), (82 Swedish; 58 Somali). They received a scheduled time ten days later with one of the two research doctors for physical tests, questionnaires and information. This time interval was required for distribution and analyses of the blood samples.

Fifth, in total 123 women (56.7% or 123/217) came to the doctors where they completed the questionnaires and the physical tests. These 123 women constituted the study population here (71 Swedish; 52 Somali women).

There were no statistical differences between the participating women and the non-participants.

Methods

Venous blood samples were collected and centrifuged. Serum vitamin D was measured using Lisason25 OH Vitamin D total assay (DiaSorin, Stillwater, USA), at the Clinical Chemistry laboratory at the University Hospital, Uppsala, Sweden, which is a certified laboratory. The other assays (ALP, PTH, Ca, albumin) were measured at Abbott Architect ci8200 (Abbott Laboratories, Illinois, USA) at the Department of Clinical Chemistry, Falun Hospital, Sweden. Hemoglobin and glucose were measured by Hemocue system (HemoCue Sweden, Ängelholm, Sweden) at the antenatal clinic participating in a quality-assessment program. ALP and PTH and free calcium in serum were analyzed to monitor metabolic skeletal activity. Hemoglobin and glucose were measured in baseline blood
samples; they are not presented here, but were screened for non-vitamin-D-related reasons for fatigue and muscular weakness.

Anthropometric measurements were performed and questionnaires on lifestyle, pain, medication, disorders and socio-cultural variables, caesarean sections, gestational age and lactation were administered by the doctors. Physical Activity was self-reported and measured as 0, 1, 2 (seldom) or ≥ 3 times weekly (often).

The participants then performed the physical tests.

General advice on sun and food was given by the doctors towards the end of the encounter.

Finally, the doctor opened the sealed envelope containing the results of 25-OH D tests, and the women with 25-OH D < 50 nmol/L were prescribed standard preparations of vitamin D and calcium. Thus, until then the doctors were blinded as to the results of the blood tests.

Grip strength and physical performance
Tests of physical function of the hand and upper leg muscles were chosen to reflect everyday practices. The upper leg tests were slightly adapted to avoid problems when performed by highly pregnant women, women who had recently given birth or had had a cesarean section.

Hand. Peak grip strength, defined as the highest value of three trials in each hand, was measured in Newton using a hand dynamometer (“GRIPPIT” AB Detektor, Gothenburg, Sweden) [35, 36]

Upper leg. Four upper leg tests were performed and rated by the doctors as done without effort (able) or not (unable).

a. Squatting. The person squatted and rose once.
b. Standing on one leg. Tested for 30 seconds [37].
c. Hip lifting test (Trendelenburg’s sign). The person stood with one hand high up on the wall and lifted the opposite leg for 30 seconds [19].
d. Ability to stand up from a chair (sit to stand). The person sat down and stood up five times with hands folded across chest.

Statistical analyses
Mean values with 95% confidence intervals (95% CI) were calculated for interval data, and median values (md) with inter-quartile ranges (IQR) for ordinal data and small numbers.

25-OH D concentrations were examined both as continuous variable normalized by transformation using the natural logarithm where the undetectable levels of 25-OH D were replaced by the figure 9, and also categorized according to standards as Undetectable (< 10 nmol/L), Deficient (10-24 nmol/L)
and Insufficient (25–49 nmol/L 25-OH D), and the higher levels Adequate (50–75 nmol/L) and Optimal (>75–250 nmol/L) \[38\].

Chi-square statistics, Mann-Whitney U test, ANOVA and t-tests were used to compare median and mean values between the two groups of women. Spearman’s rank correlation coefficient (rho) was calculated for grip strength across 25-OH D categories. Kruskal-Wallis and Mann-Whitney U test \[REV2, comment 41\] were used to calculate significant differences in distribution of inability to perform the upper leg tests across the 25-OH D categories. Pearson correlation statistics was used to explore the uni-level association between 25-OH D and grip strength \[REVII, comment 4\].

A final main effect model was calculated using stepwise linear regression in order to examine significant predictors for maximal voluntary grip strength among the independent variables: country of birth, age, height, weight, 25-OH D, physical activity, gestational age, parity and lactation \[REV 2, comment 4\].

Two-sided significance tests were used. A p-value of 0.05 or less was considered as statistically significant.

Data were analyzed using SPSS, version 17.

Ethical approval

The study was approved by the regional ethics committee in Uppsala (D 210/140), Sweden.
RESULTS AND DISCUSSION

General information
The study population included 123 women (71 Swedish, 52 Somali). The majority, 57% Swedish and 67% Somali, reported that they were completely healthy and the remainder reported allergic or gastrointestinal problems. The groups of women differed significantly in many ways. More Somali women were breastfeeding (72% vs. 29% Swedish women (p<0.05) and Somali women also when pregnant (2%) REV 2, major comment. Additional significant differences between Swedish and Somali women were in age, education, height, blood pressure and number of children: age (mean age 30.7 years; 95% CI 29.6–31.8, vs. 28.3 years; 95% CI 26.6–30.0, p<0.05), education (mean 13.8 years; 95% CI 12.9–14, vs. 3.3 years; CI 2.3–4.4, p<0.001), height (mean 167 centimeters; 95% CI 166–169, vs. 161 centimeters; 95% CI 160–163, p<0.001), systolic blood pressure (mean values 113 mmHg; 95% CI 110–115, vs. 104 mmHg; 95% CI 101–107, p< 0.001) and children (md. 1; IQR 1–2, vs. 3 children; IQR 1–5, p< 0.001). Four Swedish and two Somali women REV 2, comment 5--one of which had had a cesarean section and therefore did not perform the squatting test- had recently given birth. Four Somali women (4/52) had hemoglobin count ≤100 mol/L (89-99) during pregnancy. No woman had had significant blood loss during delivery. REV 2, comment 5

No woman used narcotics or anxiolytic analgesics. REV 2, comment 5 Mild analgesics were the only on-going medications.

The above variables did not vary significantly across the categories of 25-OH D.

25-OH D
Swedish women had higher 25-OH D levels (p<0.001) in mean 49.5 nmol/L (41.1–53.8) while the mean level for Somalis could not be calculated because one third had undetectable values. Therefore categories of 25-OH D were used in the calculations (Table 1). The first table shows that 90% of the Somali women had a deficiency with 25-OH D levels < 25 nmol/L. Notably, 35% of the Somali women had undetectable plasma 25-OH D. The Somali women with low categories of 25-OH D had particularly high PTH levels. Levels of PTH were not associated to gestational age, recent delivery or lactation. REV 2, comment 6a

To compare, 10% of Swedish women had a deficiency and 54% were insufficient, with levels < 50 nmol/L. The mean value for the Swedish women was 50nmol/L, and only 6% of the Swedish women had > 75 nmol/L.

Two variables differed significantly in distribution between categories of 25-OH D by country of birth. In the Somali group, the number of children increased in the higher the 25-OH D category...
In the Swedish group, the number of weekly physical activities increased by higher 25-OH D categories (p=0.04).

They also performed significantly better in three of four upper leg tests (p<0.001), with sit to stand as exception (see Table 2).

Table 2 shows that the Swedish women had a significantly stronger grip strength in median than the Somalis in the 10-24 and 25-49 25-OH D categories (264 vs. 211 N and 318 vs. 223 N, both p<0.05). It also shows that grip strength correlated with 25-OH D categories: overall rho 0.68; p<0.001; by country: Somali rho 0.35(p=0.01), Swedish rho 0.21(p=0.078). Three quarters (73%) of the Somali women were unable to squat and one fifth (21%) had a positive Trendelenburg’s sign but there were no statistically significant difference in distribution across the 25 OH D categories. In addition, 29% of the Somali women were unable to stand on one leg, ns across 25-OH D categories. In addition, there were no significant differences in test results between lactating or not lactating women (chi-square test).

Figure 1 illustrates that the 25-OH D concentrations (nmol/L) and grip strength (N) had a significant linear correlation (0.65, p<0.001).

The final main effect model in Table 3 shows that grip strength (N) was predicted by the 25-OH D level (B 0.94, p=0.013), adjusted for country of birth (B −63.9, p<0.001), age (B 2.5 p= 0.015) and height (B 2.6, p=0.012). Physical activity, lactation, parity and gestational age had no significant relationship to grip strength.

Discussion
In summary, one third of the Somali women had undetectable (<10 nmol/L) plasma 25-OH D, whereas nearly half the Swedish women had > 50 nmol/L. Furthermore, nearly all Swedish women had a much stronger grip than the ordinary Somali woman. Grip strength was linearly associated with plasma 25-OH D, age and height and also with country of birth. In addition, most Somali women had obvious problems with weak upper leg muscles, but this finding had no statistically significant association with low 25-OH D levels.

Our hypothesis was partly confirmed, since only grip strength had a statistically significantly association with the 25-OH D concentrations. Other factors e.g. life-style and socio-cultural attitudes towards gender roles, age, and physical activities might have contributed to the poor physical performance.
among our Somali women, especially regarding upper leg function, as suggested also by other authors [39]. Further studies are warranted to bridge this knowledge gap.

Likewise other studies, the concentrations of 25-OH D did not differ significantly between our pregnant women and new mothers [40]. Many pregnant immigrant women seem to have low 25-OH D concentrations [41]. In the United Kingdom, it was found that more than half of recent mothers with immigrant backgrounds had 25-OH D < 25 nmol/L and another 15% had <12.5 nmol/L [4, 42]. To note, our Somali women had much lower, and even undetectable concentrations.

In total, 93% of our Swedish women had a grip-strength above the Somali median value of 202 N, a value close to that performed by Swedish women in another study [35]. However, their grip strength was comparable to that measured in Ethiopian pregnant women [43]. On the whole, their poor physical performance here imply a poor general health in this sub-group of pregnant women, which might affect their ability to nurse their newborn babies [44]. Furthermore, low 25-OH D in plasma might cause poor intrauterine contractions [25, 27].

The association between 25-OH D concentrations and muscular performance is well-known particularly in elderly persons [20], but vitamin D treatment improved power in the quadriceps muscle also in a Danish study comprising 55 veiled Arabic women and 22 Danish controls [7, 9]. Ultraviolet radiation has also been suggested to improve athletic performance by elevating plasma 25-OH D [2]. Our study adds evidence that even after long-standing deprivation of UV light, the 25-OH D concentration correlates to hand-grip strength confirming that UV light affects muscle strength via 25-OH D [2]. Recently, vitamin D requirements in the United States were revised upward with regard to soft-tissue health [45]. There is no consensus in Sweden for cut-off points for vitamin D insufficiency based on serum 25-OH D [40].

The independent variable was 25-OH D. It is crucial that the method used to measure it is valid and reliable. There are different methods for measuring vitamin D and its free variants [46]. Our laboratory had consistently 10–20% lower values than the specific LC-MS reference methods used at other laboratories [24, 47].

Notably, PTH affects calcium levels via the “classical pathway” compared to the proportional effect of 25-OH D that was in focus here. Many of our Somali women, but no Swedish women had elevated and even high PTH plasma concentrations. PTH is rarely measured in primary care practice. Here PTH
was measured only in order to indicate resorption of bone mass. Rev II, comment 6a, comment 8). To compare, in another study the researchers examined the combined effects of vitamin D and PTH on physical performance [12].

Strengths and limitations
This is the first Swedish to present extremely low concentrations of vitamin D in Swedish residents, here from Somalia. This is the first Swedish study on physical performance and plasma measurements of 25-OH D. To the best of our knowledge, there are no previous published articles on grip strength, upper leg performance and 25-OH D in pregnant, or newly pregnant or lactating Rev II, major comment dark-pigmented veiled women or Swedish pregnant women, at northern latitudes. Also, this study is one of first on vitamin D status in pregnant women in Sweden, showing that 25-OH D deficiency exists also in younger Swedish women during spring, and confirms that Somali-Swedish women often are severely deficient in vitamin D with consequences on target organs. Removed text here, rev II comment 8

A strong point of our study is its real-life cross-sectional design with blood and physical tests performed during a limited period after winter Removed text here, rev II comment 9

To note, the results presented here must be interpreted with caution and should not be generalized, but they should be possible to transfer to similar populations. A limitation is the rather small study group. All findings from this study are preliminary and need further exploratory studies on e.g. attitudes to and sun exposure, veiling, food, breastfeeding during pregnancy and the role of dark-pigmented skin in real life.

Clinical significance
Maternity health care personnel should be aware of increased frequency of severe 25-OH D deficiency among young women exposed to diminutive sun radiation due to dark pigmentation and protective clothing. Notably, a grip power below 20 kg (200 N) is likely to have negative effects on child care and housework and may increase the risk of accidents. Health equity in antenatal care requires focus on nourishment status, especially in migrant women [48].

Conclusion... The Somali women had undetectable or very low 25-OH D concentrations and prominent muscular weakness in hands and upper legs where grip strength was strongly associated to the low 25-OH D concentrations. REV1, comment 1
References


33. Janson S, Schyllander J, Hansson C, Eriksson UB: [Children with a single parent are a risk group for drowning. Also immigrant children from the Middle East and Iran are at risk according to a descriptive study]. Lakartidningen 2010, 107(24-25):1618-1622.


Legend to figure 1:
Pearson correlation coefficient corr. 0.65, p<0.001. Undetectable values of 25-OH D were replaced with the figure 9 in the calculation.
Table 1. Distribution of social and clinical data of the 71 Swedish and 52 Somali women by categories of 25-OH D (nmol/L) with mean values and 95% confidence interval (95% CI) of interval data and median values (IQR) of ordinal data and number (n) and frequencies of categorical data. Significant p-values in bold.

<table>
<thead>
<tr>
<th>25-OH D Categories</th>
<th>p</th>
</tr>
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<tbody>
<tr>
<td>&lt; 10</td>
<td>10–24</td>
</tr>
<tr>
<td>Swedish, n (%)</td>
<td></td>
</tr>
<tr>
<td>7 (9.9)</td>
<td>31 (43.7)</td>
</tr>
<tr>
<td>Somali, n (%)</td>
<td></td>
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<tr>
<td>18 (34.6)</td>
<td>29 (55.8)</td>
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Variables

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</tr>
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<tr>
<td>4.8 (3.8–5.7)</td>
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<td>4.4 (3.4–5.3)</td>
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<td>5.7 (0.6–10.8)</td>
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<th>Age, years</th>
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<td>31.7 (24.8–35.6)</td>
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<tr>
<td>29.9 (28.2–31.7)</td>
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<td>31.2 (29.4–32.9)</td>
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<td>31.0 (18.7–43.3)</td>
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<tr>
<th>Height, cm</th>
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<tbody>
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<tr>
<td>164 (158–169)</td>
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<td>168 (166–170)</td>
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<tr>
<td>167 (165–170)</td>
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<td>171 (163–179)</td>
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<td>155</td>
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<tr>
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<td>–</td>
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<tr>
<td>6.3 (4.3–8.4)</td>
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<tr>
<td>6.1 (5.3–7.0)</td>
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<td>5.9 (5.1–6.8)</td>
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<th>Parity, n</th>
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<tr>
<td>1 (0–2)</td>
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<tr>
<td>1 (0–2)</td>
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<tr>
<td>1 (1–1.5)</td>
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<th>Activity/week., n</th>
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<tr>
<td>3 (2–6)</td>
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<td>2.5 (1–5.5)</td>
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<td>3 (1–3)</td>
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Analysis of variance test of variance (ANOVA) of significant differences in means between groups of interval data. Kruskal-Wallis test for significant differences in medians across categories of 2-OH D.
Table 2. Categories of 25-OH D concentrations (nmol/L) and the median (md) values of grip strength (0–600 Newton) with inter-quartile ranges (IQR) and the number (%) of women by country of birth being unable to perform the upper leg muscle tests unaided. Significant p-values in bold.

<table>
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<tr>
<th>25-OH D Categories</th>
<th>&lt; 10</th>
<th>10–24</th>
<th>25–49</th>
<th>50–74</th>
<th>≥ 75</th>
<th>rho*</th>
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<td></td>
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<td></td>
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<tr>
<td>Somali, n</td>
<td>18</td>
<td>29</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Grip strength, md (IQR)</td>
<td>173</td>
<td>223</td>
<td>311</td>
<td>326</td>
<td>313</td>
<td>0.68</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Swedish</td>
<td>264*</td>
<td>318*</td>
<td>327</td>
<td>313</td>
<td></td>
<td>0.21</td>
<td>.078</td>
</tr>
<tr>
<td>Somali</td>
<td>173</td>
<td>211</td>
<td>223</td>
<td>292</td>
<td></td>
<td>0.35</td>
<td>.012</td>
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<td>Inability to: n (%)</td>
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<tr>
<td>Squat, n (%)</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td>.33</td>
<td></td>
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<tr>
<td>Sit to Stand n (%)</td>
<td>15 (83.3)</td>
<td>18 (64.3)</td>
<td>4 (100)</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Trendelenburgh n (%)</td>
<td>1 (5.6)</td>
<td>1 (3.6)</td>
<td>0</td>
<td>0</td>
<td></td>
<td>.65</td>
<td></td>
</tr>
<tr>
<td>Stand on one leg n (%)</td>
<td>5 (27.8)</td>
<td>5 (17.2)</td>
<td>1 (25.0)</td>
<td>0</td>
<td></td>
<td>.46</td>
<td></td>
</tr>
</tbody>
</table>

* Spearman rho with p-values below
* p< 0.05 Mann-Whitney U test compared to the group below

Table 3. Final main effect model using linear regression with stepwise exclusion for maximal voluntary grip strength in 123 pregnant and new mothers. Unstandardized (B) with 95% confidence intervals (95% CI) and p-values. Significant p-values in bold.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-OH D</td>
<td>0.94</td>
<td>(0.21–1.68)</td>
<td>.013</td>
</tr>
<tr>
<td>Country</td>
<td>63.9</td>
<td>(-97.9 – -29.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age</td>
<td>2.5</td>
<td>(0.15 – 4.60)</td>
<td>.015</td>
</tr>
<tr>
<td>Height</td>
<td>2.6</td>
<td>(0.59 – 4.65)</td>
<td>.012</td>
</tr>
</tbody>
</table>

Independent variables included at the first step: country of birth, 25-OH D, age, height, weight, physical activity, lactation, parity, gestational age.
Figure 1