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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 2/2021 (21) KWARTALNIK ISSN 1642-0136

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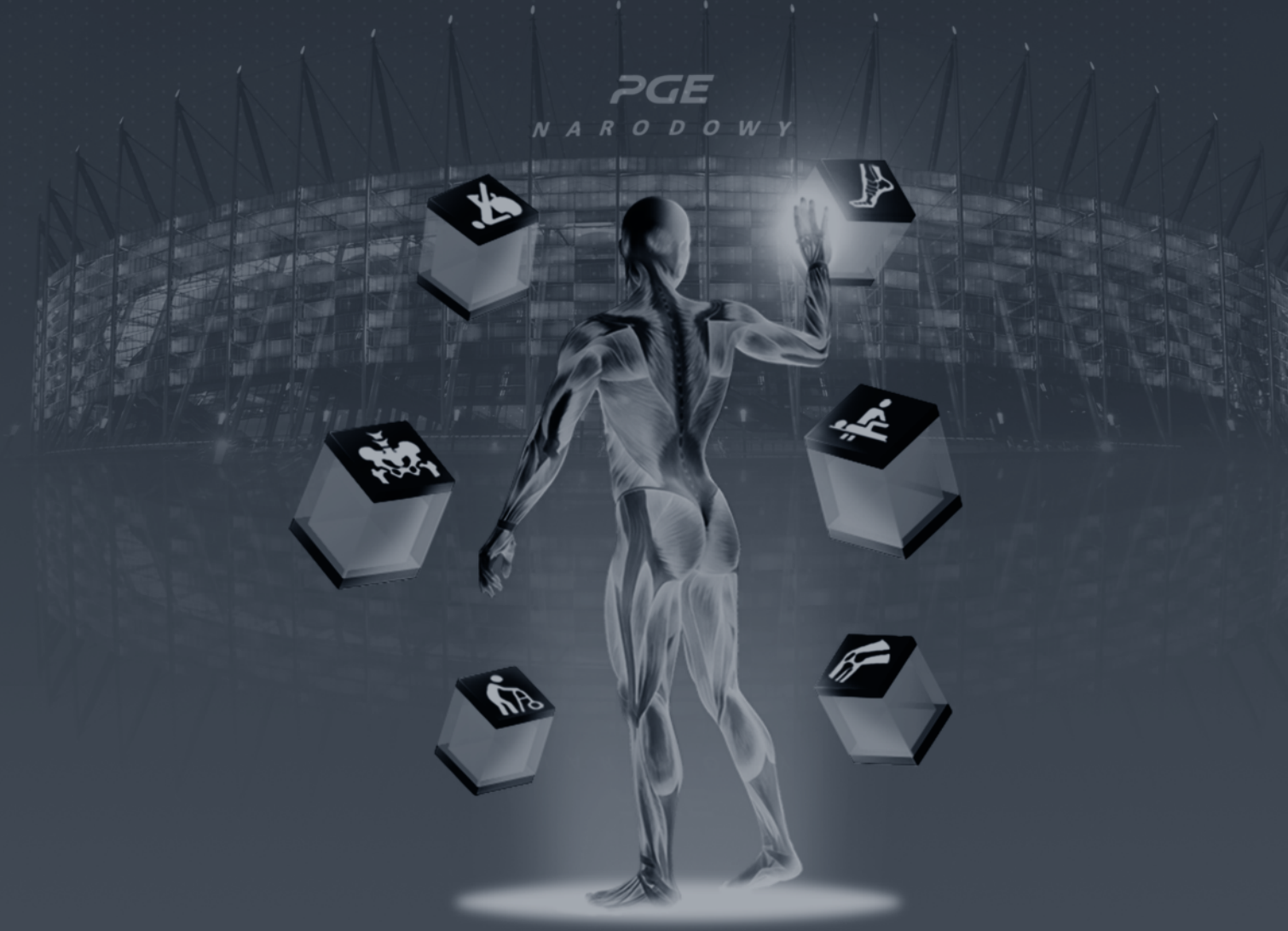

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nr 2/2021 (21)

Effect of Anemia on Fatigue and Oxygen Saturation levels in Menopausal Anemic Women

Wpływ niedokrwistości na poziom zmęczenia i saturację u kobiet z niedokrwistością w okresie menopauzy

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Abstract

Background. Reduced number of red blood cells and hemoglobin defined as anemia which lowering the capability of the blood to deliver oxygen to all body tissues. Anemia leads to fatigue and dyspnea on exertion, which can decrease a patient's ability to accomplish normal daily living activities. Platelets and red blood cells aggregation increase with age, which decreasing the delivery of oxygen to the tissues by elevating blood viscosity flow in the microcirculation. Purpose. The purpose of this study is to determine the effect of anemia on Fatigue and Oxygen Saturation levels in Menopausal Anemic Women. Methods. An Observational case control study design, convenience sample of 50 menopausal women, their age ranged between 45 to 55 years old were divided into two groups (A&B). Group A consisted of 25 non-anemic women while, Group B consisted of 25 anemic women. All participants were evaluated through 6MWT for endurance, BS scale for exertion, FSS for fatigue and PULSE OXIMETER for oxygen saturation. Results. Statistical analysis showed that there was a significant decrease ($p < 0.05$) in endurance and oxygen saturation of group (B) compared with group (A) and also there was a significant increase ($p < 0.05$) in fatigue level and exertion level of group (B) compared with group (A), Conclusions: Anemic menopausal women have higher fatigue and exertion levels and lower endurance and oxygen saturation levels than non-anemic menopausal women.

Key words:
Anemia, Fatigue, Menopause

Streszczenie

Informacje wprowadzające. Zmniejszona liczba czerwonych krwinek i hemoglobiny definiowana jako anemia, która obniża zdolność krwi do dostarczania tlenu do wszystkich tkanek ciała. Niedokrwistość prowadzi do zmęczenia i duszności wysiłkowej, co może zmniejszyć zdolność pacjenta do wykonywania normalnych codziennych czynności życiowych. Z wiekiem wzrasta agregacja płytek krwi i czerwonych krwinek, co zmniejsza dopływ tlenu do tkanek poprzez zwiększenie lepkości przepływu krwi w mikrokrążeniu. Cel. Celem tego badania jest określenie wpływu niedokrwistości na poziom zmęczenia i saturację u kobiet z niedokrwistością w okresie menopauzy. Metoda. Projekt kontrolnego badania obserwacyjnego, próba okolicznościowa. 50 kobiet w okresie menopauzy, w wieku od 45 do 55 lat, podzielono na dwie grupy (A i B). Grupa A składała się z 25 kobiet bez anemii, podczas gdy grupa B składała się z 25 kobiet z anemią. Wszystkie uczestniczki były oceniane za pomocą 6MWT pod kątem wytrzymałości, skali BS dla wysiłku, FSS dla zmęczenia i PULSOMETRU pod kątem saturacji. Wyniki. Analiza statystyczna wykazała, że nastąpił istotny spadek ($p < 0,05$) wytrzymałości i saturacji w grupie (B) w porównaniu z grupą (A), a także istotny wzrost ($p < 0,05$) poziomu zmęczenia i poziomu obciążenia grupy (B) w porównaniu z grupą (A). Wnioski: Kobiety po menopauzie z niedokrwistością odczuwają wyższy poziom zmęczenia i obciążenia oraz mają mniejszą wytrzymałość i saturację niż kobiety bez anemii w okresie menopauzy.

Słowa kluczowe:
anemia, zmęczenie, menopauza

Introduction

Anemia is a disease in which hemoglobin, hematocrit, and erythrocytes levels fall below the normal value. The World Health Organization clarified anemia as hemoglobin concentrations below 12 g/dL in females and 13 g/dL in males [1].

Anemia is more common in women than men, and according to the WHO, the propagation of anemia among women is 21-80% worldwide [2]. Anemia negatively impacts life, as it considered the most important factor that decreases the women's health and their work performance, especially in their reproductive years, and leads to high infant and maternal mortality rate. According to the WHO, 40-89% of anemia among women is characterized as iron-deficiency anemia [3].

Above the age of 75 years, anemia is disproportionately affects females, with prevalence in women 65 years old and older in the United States is 10% [4]. "Iron deficiency" defined as reduced levels of blood iron below the normal range without anemia (standard hemoglobin values). "Iron-deficiency anemia" defined as both low blood iron levels and anemia (hemoglobin below normal levels). "Severe anemia" defined as both low blood iron levels and hemoglobin ≤ 7 g/dL [5].

The post-menopausal phase in women is characterized by high estrogen level deficiency. Accelerated loss of bone mass resulting from both menopause and aging. Menopause causing imbalance between bone formation and resorption, and when resorption is excessive, resulting in a negative remodeling balance [6].

At menopausal stage, declining estrogen levels, and reduced activity result in musculoskeletal impairments, muscle weakness and low blood cells count [7].

Properties of blood change in older people, these changes might lead to increase the incidence of clot consistence and atherosclerosis. Some of the eminent changes include: Elevation of fibrinogen, blood and plasma viscosity and red blood cell toughness. Also, increase the fibrin degradation products and faster activation of the blood coagulation system [8]. An age-dependent raise in several coagulation factors, there is a positive correlation with fibrinogen and a negative correlation with plasma albumin. Platelets and red blood cells aggregation increased with age. Red blood cells aggregation is the main factor which responsible for increasing blood stickiness at low shear rates. Low red blood cells deformability indicates its capability to deform under flow forces. Few deformable cells show more impedance to diffuse in the microcirculation, thus, decreases the oxygen transfer to all body tissues. Some studies have illustrated that older adult people have red blood cells with low fluid membranes [9].

The immunologic theory, the free radical theory, the inflammation theory and the mitochondrial theory are the main theories of aging which specific of a particular cause of aging, which providing important insights for the understanding and explaining of the physiological changes which occurring with aging [10]. Anemic elderly people in the society have a reduced functional capacity and elevated risk of balance disturbances and falling. Incidence of balance impairments and falling may be due to deterioration of physical activities and activities of daily living, causing a reduction in muscle power, gait speed, balance and mobility [11].

Persons with anemia are more likely to be frail, fatigued, have impaired grip strength, have decreased functional status, more likely to fall, have fractures, be cognitively impaired and have overall increased mortality than their non-anemic counterparts [12]. So, the current study was conducted to investigate the effect of anemia on fatigue and oxygen saturation levels in menopausal anemic women.

Subjects and Methods

Study Design

An observational cross sectional study was designed to provide objectively the effect of anemia on fatigue and oxygen saturation levels in menopausal anemic women. The study was conducted between March 2019 to September 2020. The research related to human use has been approved by authors institutional review board at Faculty of Physical Therapy, University of Cairo with reference number [P.T.REC/012/002675].

Participants

A sample of fifty menopausal women were participated in the study, participants age was ranged from 45 to 55 years, BMI was ranged between (19.9-29.9) kg/m2, HB level was ranged between (10 g/dL-12g/dL) and Erythrocytes count was ranged between (3.8-5 Mil/mm). They were selected from outpatient clinic of Faculty of Physical Therapy-Delta University for Science and Technology, Gamasa, Egypt after signing consent form. Exclusion criteria included end stage renal failure, heart failure, cancer patient, chronic obstructive lung disease, cardiac patient and sever orthopedic disorders.

Groups Assignment and Determination

Participants were assigned into two groups (group A) (n = 25) normal menopausal women and group (B) (n = 25) anemic menopausal women. Both groups were received the same methods of assessment.

Materials

Laboratory investigation

Standardized kits were used to assess complete blood picture.

Height and weight scale

It was used to measure the height and the weight. It is metal device consisting of vertical scale for measuring height and transverse scale for measuring weight to calculate the body mass index of each woman.

Pulse oximetry

It was used to measure oxygen saturation and pulse rate." More specifically" it was used to measure the percentage of hemoglobin in the blood which bounded to oxygen.

Borg scale
It was used for assessment of the level of exertion. It ranges from (6 to 20), selection of number 6 refers to "no exertion at all" and selection of number 20 refers to "maximal exertion". This scale determines the difficulty of activity and we may encourage the woman by words such as speed up or slow down movements to reach the required level of intensity.

The 10 Meters Six-Minute Walk Test
It was used for assessment of endurance level or physical capacity.

Fatigue assessment questionnaire
It was used for assessment of fatigue.

Stopwatch
It was used during six-minute walk test to measure the amount of time taken to perform the test from the beginning to the end of the test.

Evaluative Procedures
Complete blood picture
Hemoglobin concentration (Hb) was measured to detect possible differences in the oxygen carrying capacity between groups and Red blood cells count (RBCs). Blood samples were collected as: Venous blood sample of 5 cm was drawn from the antecubital vein of each patient by a needle using (an Autoclix Apparatus). The blood sample was transferred to a glass tube. The serum was separated from the plasma and the serum was analyzed to determine the level of the hemoglobin in blood using SISMEX SE- 2100 electronic counter (Sysmex Corporation Kobe, Japan) to determine complete blood picture (CBC) [13].

The 10 Meters Six-Minute Walk Test
Women were instructed to wear Comfortable clothes and appropriate shoes for walking and possibility of using the assistive aids (Cane, walker, etc.). The woman was asked to take small meal before early morning or early afternoon Tests with continuation of the women's usual medical regimen. Women were not exercised vigorously within 2 hours before beginning of the test. Required equipment: stopwatch, two small cones to determine the turnaround points. Easily moving chair used along the walking tunnel, worksheets, Borg scale for dyspnea. The test was performed in 10-meter flat and straight corridor with cones placed at each end of the course. Women were asked to walk at their own pace on the 10-meter course of the test, and to cover as much distance as possible during the 6 min. Women can stop the test and rest but they asked to continue walking as soon as they are able. Verbal encouragement was provided every 30s. The test immediately stopped when they complain of any of the following: intolerable dyspnea, chest pain, leg cramps, diaphoresis, staggering, and pale or ashen appearance. If a test was stopped for any of these symptoms, the woman advised to sit or lie supine [14].

Borg scale
Women were asked to appraise her feeling of exertion as honestly as possible. Woman looks at the scales and the expressions, then she gives a number (used 9: refers to "very light" activity. It is same as walking slowly for several minutes corresponding to normal woman, used 13: refers to "somewhat hard" activity, but the woman feels better and continue, used17: "very hard" is very strenuous activity). Normal woman can still continue by pushing herself, but she feels very tired. Used 19: on the scale refers to "extremely strenuous" activity. Most women illustrated that, this is the most strenuous activity they have ever do [15].

Fatigue assessment questionnaire
The following procedures were conducted to apply the questionnaire: have agreement from each woman to participate in the study, starts in questionnaire items, questionnaire items were taken face to face with each woman, all questions were achieved by each woman, explain questions for each woman and finally collect data for statistics. The following instructions for each woman were given to complete the questionnaire: you must answer all questions, when you experienced questions that may look like others you must take a good time to read and answer each question with great attention as each one is different. Then fill the bubble that represents your answer [16].
Fatigue severity scale scoring steps: Add all the numbers the patient circled to get your total score. We suggest that the woman was not be fatigued when the total score of the scale less than 36 and total score of 36 or more suggested fatigue [17].

Oxygen saturation assessment by pulse oximetry
A small clamp-like device was placed on a finger for measuring the amount of oxygen in the blood and heart rate [18].
Procedure steps: A clip-like device was placed on woman's finger to observe the pulse and oxygen saturation. When we need to monitor the physical function abilities, the oximeter kept during the exercise and during the recovery period. Sometimes, it was only used for taking a single record very quickly, and once the test ended, the clip removed. An oxygen saturation level of 95% is considered normal for most healthy women, but a level of 92% indicates potential hypoxemia or reduced oxygen reaching tissues in the body.

Statistical analysis
Descriptive statistics, including mean ± SD, were quantified for all variables. Potential differences in baseline demographic between groups were examined using independent sample t-tests Reported data was analyzed using Statistical Package for Social Sciences (SPSS) computer program (version 25 windows) (IBM SPSS, Chicago, IL, USA).

Results
There was no statistical significant difference in the mean value of age, weight, height and BMI between the two groups ($p > 0.05$) (table 1).

Table 1. Subject characteristics

	Group A x̄ ± SD	Group B x̄ ± SD	t-value	p-value
Age [years]	50.04 ± 2.91	49.24 ± 2.86	0.98	0.332
Weight [kg]	71.6 ± 7.47	72.24 ± 9.18	−0.27	0.788
Height [cm]	1.67 ± 0.06	1.69 ± 0.05	−1.246	0.219
BMI [kg/m²]	25.7 ± 2.73	25.32 ± 3.32	0.447	0.657

There was statistical highly significant difference in the mean value of hemoglobin level and erythrocytes count between both groups A and B ($p < 0.05$) (table 2).

Table 2. Mean value of Hemoglobin level and Erythrocytes count between both groups A and B

	Group A x̄ ± SD	Group B x̄ ± SD	t-value	p-value
HB	12.94 ± 0.58	10.66 ± 0.19	18.784	0.000
RBCs	4.85 ± 0.25	3.93 ± 0.2	14.534	0.000

There was statistical highly significant difference in the mean value of fatigue level, level of exertion, endurance level and oxygen saturation level between both groups A and B ($p < 0.05$) (table 3).

Table 3. Mean value of endurance level, response to fatigue, level of exertion and oxygen saturation between both groups A and B.

	Group A x̄ ± SD	Group B x̄ ± SD	t-value	p-value
(FSS) Fatigue level	saturation	98.04 ± 0.73	95.04 ± 0.98	12.261
(BS) Level of exertion	33.36 ± 1.85	48.76 ± 5.25	−13.845	0.000
(6MWT) Endurance level	11.64 ± 1.15	16.08 ± 1.53	−11.62	0.000
(SPO2) Oxygen	556.96 ± 13.77	456.56 ± 24.9	17.641	0.000

Discussion

Anemia is a decreased hemoglobin values beneath 12 and 13 g/dL for females and males respectively. Approximately one third of the anemic patients associated with nutritional deficiencies such as iron, B12 vitamin and folic acid, and the another third associated with kidney and chronic inflammatory diseases, but the last third not associated to any specific causes according to the World Health Organization [19].

Beyond the possible adverse effect of iron deficiency on muscle function, symptoms like fatigue and muscle weakness are correlated with low level iron, therefore it leads to a reduced recovery period [20].

Qamar K et al. [21] concluded that, malabsorption, defined as the difficulty of gastrointestinal tract to absorb ingested nutrients and micronutrients, which may be the major cause of iron deficiency with anemia in postmenopausal women.

The current study aimed to study the effect of anemia on fatigue and oxygen saturation levels in menopausal anemic women. This was evaluated by doing fatigue severity scale, borge scale, 6minutes walk test and oxygen saturation.

The results of the present study showed that, there was statistical highly significant difference in the mean values of fatigue, exertion, endurance and oxygen saturation levels between both groups A and B ($p < 0.05$).

The results of the present study were supported by Neidlein S et al. [22] who measured serum Ferritin, iron, transferrin, and blood hemoglobin as well as Fatigue using the fatigue scale and handgrip strength, and isometric knee extension strength of Two hundred twenty-four hospitalized patients their age between 65–95 years; 67% females. The results showed that, 41% had iron deficiency but the majority of them suffered from functional iron deficiency with low SPPB and high fatigue level which significantly associated with iron deficiency. Physiological muscle degradation with age leads to decrease muscle function and strength.

Also, Pozzo J et al. [23] reinforce the results of the present

study as they studied the effect of iron deficiency anemia on physical function abilities and survival in patients with chronic systolic HF by comparing peak VO2 and the 6-minute walking test in patients with AID and patients without AID. The results founded that, patients with HF with absolute iron deficiency anemia having reduced functional capacity, poorer 6-minute walking test and poorer peak exercise oxygen consumption as patients with HF. AID result from decreased iron intake or absorption because of edema of the intestinal mucosal. Thus, limits the ability of the individual to do oxidative metabolism.

The results of the present study come in agreement with Wratsangka R and Putri RA. [24] which reported that, low hemoglobin value is an important marker of functional limitations and physiological decline. Although aging may cause low hemoglobin level, anemia in the elderly plays a role in their morbidity and mortality rate, influences their quality of life and all aspects of physical, mental, and social health.

The findings of the present study matched with Bosco RD et al. [25] who assessed the relationship between anemia and physical function in 709 old hospitalized patients, their age above 60 years. 30% of the patients be anemic with markedly decreased functional ability according to the daily living activity.

Sobrero A et al. [26] investigated the same goal, when assessing the impact of fatigue and non-fatigue symptoms of anemia on quality of life in cancer patients, found that, fatigue is a common complaint of patients with cancer with estimated prevalence (about 70% to 90% in different surveys). Moreover, fatigue is multifactorial, the abnormalities in energy metabolism considered the main cause of fatigue. In cancer patients, fatigue induced by the elevated metabolic activity needed as a result of tumor growth. So, this study investigated the impact of hemoglobin values on fatigue and quality of life.

Also, Chaves PH et al. [27] support the present study who evaluated the functional ability of women ages 65 and over using balance tests, sitting and getting up from the chair test and the walking speed test. Woman who reported Hb values ranged from 13 to 14.g/dL illustrated high functional ability results than woman who reported Hb values of 12 g/dL, also, the study showed that, woman who had hemoglobin values beneath13.4 g/dL might have a higher mortality rate.

Also, Thein M et al. [28] reinforce the results of the present study as, they evaluate the quality of life and the ability of old people to function well. The results showed that, Hb levels less than normal resulting in worsening the quality of life among old persons who had mild degree of anemia (hemoglobin values ranged from 10 to 12 g/dL). Anemia is the main cause of elevated disability, reduced muscle strength and power, fatigue, and psychological symptoms. [28].

The results of the present study supported by Penninx BW et al. [29] who assessed the functional capacity of 1156 senior people, Inferior limb muscle strength and hand palm pressing strength, as well as activity of daily living by using the four-meter walking test and balance evaluation. Elderly adults having anemia reported worse result in the tests and the same also after control of age, sex and other variables.

Also, the results of the present study agreed with Sanford A.M and Jorley E. [30] they demonstrated that persons with anemia are more likely to be frail, fatigued, have impaired grip strength, have decreased functional status, more likely to fall, have fractures, be cognitively impaired and have overall increased mortality than their non-anemic counterparts. As anemia of old age reduces bone marrow erythroid progenitors which decreases the amount of red blood cells released into the circulation.

Boutou, AK et al. [31] also, supported the present study as the results founded higher dyspnea and lower peak of oxygen consumption in anemic chronic obstructive pulmonary disease patients. The results showed a lower anaerobic threshold in anemic patients associated with low oxygen supply due to anemia. Their results suggested that, exercising with high intensity level resulting in lowering oxygen supply in anemic COPD patients.

Conclusions

Based on the study findings, it can be concluded that anemic menopausal women have higher fatigue and exertion levels and lower endurance and oxygen saturation levels than non-anemic menopausal women.

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Acknowledgments

Thanks to all individuals who contributed to the completion of this work.

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