

Original Research Article

## Quality of Life and Dietary Assessment of Attention-Deficit Hyperactivity Disorder (ADHD) Patients

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### ABSTRACT

**Introduction:** Attention-deficit hyperactivity disorder (ADHD) is a common neuro developmental disorder among children. It comprises of a range of behavioural problems that can have adverse effects on academic performance, vocational success, and social-emotional development. Because of the rise in ADHD and other psychological disorders, the focus is shifting toward the potential role that the diet and nutrition may play that can be positively or negatively related with the disease. Many dietary interventions have been proposed since ADHD children have many food sensitivities which may enhance the symptoms of the disorder if dietary regimen is not followed strictly.

**Objective:** Keeping in mind the lack of awareness among parents specially residing in Saudi Arabia regarding a proper diet in ADHD children, this study was carried out to assess ADHD children's dietary habits and their impact of their quality of life.

**Methodology:** A sample of 74 subjects (age 4-10 yrs) were randomly selected from Human Development Centre in Riyadh, Saudi Arabia with a prior approval from the Centre and a consent from participants. The dietary intake was assessed using a food frequency questionnaire and their quality of life was evaluated using Weiss Functional Impairment Rating Scale Questionnaire.

**Results:** The food frequency questionnaire results showed most of the subjects were not adhering to the diet recommended by Feingold's diet for ADHD children and most of them were consuming foods low in essential fatty acids, Vitamin B complex, and high in preservatives, artificial flavours and colours.

**Conclusion:** There is no awareness among the caretakers regarding proper diet for ADHD children which seems to show signs of an impact in their quality of life.

**Keywords:** Attention-deficit hyperactivity disorder, Feingold's diet, Quality of life.

### INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is defined as a neurobehavioral developmental disorder characterized by continuous inattention, hyperactivity, and impulsiveness and is especially prevalent in childhood. [1,2] Children with ADHD have three subtype symptoms: predominantly hyperactive-impulsive, predominantly inattentive, and

combined hyperactive-impulsive and inattentive. [2-4] The etiology of ADHD involves genetic, dietary, and environmental factors.

Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders with a worldwide prevalence of ~5%. [5] The prevalence is even higher among school-age children ranging from 8% to 12% [6-8]

and can persist into adolescence and adulthood inflicting long-term harm. [9] The results of studies using Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria suggests the prevalence of ADHD is as high in many non-US children as in US children but it is difficult to make exact comparisons between countries because the estimated prevalence is highly influenced by the means of assessment and the type of sample recruited. [8]

Other than ADHD being an inherited disorder, [10] a number of early developmental risk factors have also emerged as significant predictors of ADHD and its symptoms. Associations between ADHD and prenatal exposures to factors, such as smoking, alcohol, illegal drugs, and medications that affect the mental state, premature birth and low birth weight and of maternal stress during pregnancy have been linked ADHD. [2,11-13]

The effect of diet and nutrition on ADHD is also an important issue that needs attention. Balanced nutrition is very important during childhood, which is a period of vigorous growth, increased activity, and development of body functions and social cognitive ability. With rapid economic growth, increased personal income and advances in food processing and manufacturing industries, the proportion of processed foods (e.g. snacks and cakes) in children's dietary life has noticeably increased. [2,14,15] A study on relationship between diet and brain electrical activity in children with ADHD found certain food sensitivities not only influence ADHD symptoms, but may also alter brain electrical activity. This research underscores the need for practitioners to understand the role of nutrition in ADHD. In the past two decades there has been increasing interest in various aspects of diet that may adversely affect hyperactive children. Particular attention has focused on the role of food additives, refined sugars, and fatty acid metabolism. [16]

Several studies have reported the benefits of essential fatty acid (EFA) in children with attention disorders since these children have low EFS levels. [17] Learning and behavioral difficulties are common among children and adults with ADHD, and foods rich in omega-3 fatty acids may help reduce behavioral problems and enhance learning. [18] Supplementation using very high doses of vitamins and/or minerals to treat ADHD is another intervention that has been proposed, but there are no well-controlled studies supporting this hypothesis. A few studies have also documented iron and trace mineral deficiencies in children with ADHD. [19] Untreated iron deficiency can lead to behavioral problems and supplementing diets with iron and trace minerals would benefit the child, but there have not been any controlled studies to verify this. [19] Similarly, Vitamin B complex is essential for proper brain function. Vitamin B-5 helps the brain produce tranquilizing chemicals that may reduce hyperactivity and behavioral disturbances associated with ADHD. [18] Niacin, or vitamin B-3, may enhance circulation to the brain, helping to deliver vital nutrients to support cognition, memory and social while Vitamin C is a powerful immune system enhancer, which may prevent illnesses that can increase symptoms of ADHD. [18] Another dietary intervention relates to the belief that sugar causes hyperactivity and the ADHD child would need to eliminate all forms of sugar from the diet. [20]

Epidemiological and nutritional studies on psychiatric disorders are very rare in the Arab World. ADHD commonly affects school children and adolescents, and is frequently encountered in clinical settings in the Arab World. The problems of ADHD children can place a lot of strain on family functioning. In many Arab countries, families may not accept their children's mental health problems and their need for treatment for fear of labeling

and stigma which may lead to overlooking important needs these patients may have. There is very little awareness about the treatment of ADHD patients in the Arab world. [21] Normal treatment protocols today use medication as well as behavioral therapies. [22] Depending on nutritional status of the ADHD patient, the worsening of the symptoms may be avoided if dietary intervention is also followed. However, information on the assessment of nutritional status and its impact on the prognosis of ADHD are still rare and even rarer in the Arab world. Therefore, the aim of this study is to assess the nutritional status of ADHD patients and observe its impact on their quality of life.

## **MATERIALS AND METHODS**

### ***Study design and setting***

The study is a Cross sectional study and the ADHD participants were selected from Human Development Centre in Riyadh, Saudi Arabia.

### ***Subjects***

A total of 74 Saudi children with ADHD, from 4 to 10 years of age (boys and girls), were selected from human development centre. The Exclusion criteria included subjects with no care givers and patients with severe mental disorders. Approval to conduct the study was obtained from the Human Development Centre in Riyadh, KSA, and consent was obtained from the families before administering a structured questionnaire to the study participants. The study was approved by the ethical committee and the IRB of the College of Applied medical sciences. The questionnaire was administered in person by trained study personnel.

### ***Assessment tools***

The study tools included dietary assessment questionnaire, anthropometric measurement and Weiss Functional Impairment Rating Scale Questionnaire.

### ***Anthropometric assessment***

Anthropometric variables included body weight and height measurements. Body

weight was measured to the nearest 100 g using calibrated portable scales. Measurements were done with minimal clothing and without shoes. Height was measured to the nearest centimetre using a calibrated measuring scale in a full standing position. Body mass index (BMI) was calculated by the CDC Growth Charts for every participant. Dietary Habits were examined with the use of carefully constructed questionnaires.

### ***Dietary assessment***

The presence of ADHD was pre-diagnosed by the doctors in the clinic using a reliable and validated questionnaire of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), a person with ADHD must have at least six of the listed symptoms of inattention or symptoms of hyperactivity-impulsivity that have persisted for at least 6 months to a degree that is maladaptive and inconsistent with the person's developmental level. [23] Dietary assessment was attained by a Food frequency questionnaire which was filled by the patient's care taker. Details regarding food intake was explained using food models to illustrate serving sizes.

### ***Quality of Life Assessment***

The quality of life of the participants was assessed using Weiss Functional Impairment Rating Scale which is a clinician-friendly tool completed by a parent or adolescent/adult that scores distinct domains such as school [learning and behaviour] or work, family, social, leisure, self-concept, and risky activities). The scale is available in the public domain at [www.caddra.ca](http://www.caddra.ca) and is free and designed to facilitate clinical as well as research use. [24-26] The result of scoring was reported as: not impaired, mildly impaired and impaired depending on the score.

### ***Data Analysis***

Data analysis was done using Microsoft Excel 2010. Descriptive

statistics (frequency and percentages) were calculated for participant's demographic and dietary knowledge assessment.

## RESULTS

**Table 1. Socio-Demographics and characteristics for the participants**

Characteristics	Frequency n (%)
Total participants who completed the study	74
Age (4 to 10 years) Mean $\pm$ SD	6.51 $\pm$ 1.74
Gender	
male	60 (81.08%)
female	14 (18.91%)
Body Mass Index (BMI)	
Underweight = < 5%	7 (9.45%)
Normal = 15% to 85%	25 (33.78%)
Over weight = >95%	42 (56.75%)
Caretakers Education level	
High school	14 (18.08%)
Bachelor	60 (81.91%)

Table 1 lists the social characteristics of the study participants and their caretakers. A total of 74 participants completed the study, of which 81.08% were males and 18.91% were females. The mean age of the participants was 6.51  $\pm$  1.74 years. The Body Mass Index (BMI) was calculated by the CDC Growth Charts for every participant. It was seen that 9.45% were underweight, 33.78% were normal weight and 56.75% were overweight. When asked about the

education and social status of the caretakers responsible for the participants, 18.08% agreed to have completed their high school while 81.91% had Bachelor degrees.

Details about the caretaker's knowledge of ADHD can be seen in Table 2. When asked whether they know what ADHD is, only 4.05% disagreed compared to 95.94% who knew what ADHD is. Out of the 74 participant's caretakers, 63.51% thought ADHD was not a serious disorder while 36.48% thought it to be a serious disorder. 63.51% had no idea what are the causes of ADHD while 36.48% had some idea. When asked about any genetic link in the family, 77.02% reported no other relative having the disorder while 22.97% reported one or more relative having the disorder. Out of the 74 participants, 59.45% had a good appetite, while 17.56% reported an excellent appetite and 22.97% were poor in eating. Feingold diet is a recommended diet plan for children with ADHD and autism, and when asked whether the caretakers had any idea about Feingold diet, 95.94% had no idea at all while only 4.05% had heard of it. None of the participants were on any medication.

**Table 2. Knowledge assessment of the caretakers of Attention Deficit Hyperactivity Disorder children**

Questions	Frequency n (%)
Do you know what Attention Deficit Hyperactivity Disorder is?	
Yes	71 (95.94%)
No	3 (4.05%)
Do you think it's a serious problem?	
Yes	47 (63.51%)
No	27 (36.48%)
Do you know causes of attention deficit hyperactivity disorder?	
Yes	27 (36.48%)
No	47 (63.51%)
Does the child have relatives suffering from attention deficit hyperactivity disorder?	
Yes	17 (22.97%)
No	57 (77.02%)
How do you describe the patients appetite:	
Poor	17 (22.97%)
Good	44 (59.45%)
Excellent	13 (17.56%)
Have you heard about Feingold diet:	
Yes	3 (4.05%)
No	71 (95.94%)
Is the patient on any kind of medication?	
Yes	0
No	74 (100%)

**Table 3. Food Frequency Questionnaire**

Essential fatty acid Source: Flax seeds, Walnuts, Chinook, salmon, Scallops, Soybeans, Shrimp, Snapper, Winter squash, Tuna, Cod, Kidney beans						
	Never	1-3 times / month	Once/ week	2-4 times / week	One or more times/day	NA
Mean %	78.51	7.02	2.07	2.07	0.41	9.92
Vitamin B Complex Source: Sesame butter, Sesame seeds, Fish, Pecans, Macadamia nuts, Pistachios, Pine nuts, Dried herbs and spices, Sunflower seeds, Yeast, Almonds						
Dry roasted soybeans, Liver, Sun Dried Tomatoes, Wheat bran, Sunflower oil, Paprika, Peanuts, Veal, Chicken, Avocados, Garlic (raw), Molasses, Hazelnuts, Oysters, Caviar						
	Never	1-3 times / month	Once/ week	2-4 times / week	One or more times/day	NA
Mean %	67.66	9.79	2.80	6.99	3.32	9.44
Foods containing Salicylates: Apricots, Grapes, Oranges, Pineapple, Raisins, Raspberries, Olives, Mushrooms, Radish, Blackberries, Blueberries, Dates, Guava						
	Never	1-3 times / month	Once/ week	2-4 times / week	One or more times/day	NA
Mean %	57.69	10.49	3.85	9.09	4.20	14.69
Foods containing colours -preservatives –flavours: Gummy bears, Lollipops, Colourful cereals, M&Ms, Nuggets, Microwave popcorn, , Reese's, Indomie, Diet soft drinks, Gums, Artificial sweeteners, Ice cream, Gelatine, Candy						
	Never	1-3 times / month	Once/ week	2-4 times / week	One or more times/day	NA
Mean %	9.09	7.47	16.88	51.30	4.87	10.39

Table 3 gives an idea about the type of diet the participants had, and it was seen that most of the participants were not following a healthy diet plan. Foods rich in essential fatty acids were not being consumed by 78.51% while only 7.02% were having it 1-3 times per month and only 2.07% took foods rich in essential fatty acids once to four times per week. Foods rich in vitamin B complex was also not taken by 67.66% of the participants, while 9.79% consumed them once to 3 times per month. Only 2.80% had it once a week and 6.99% took foods rich in vitamin B12 2 to 4 times per week. Around 3% had vitamin B complex rich foods once per day. A similar trend was seen for foods rich in Salicylates. As seen, 57.69% did not follow a diet that was rich in salicylates, while 10.49% had these foods at least 1 to 3 times per month, only 3.85% and 9.09% had them once every week or 2-4 times respectively, while 4.02% consumed such foods once a day. On the other hand, most of the participants were taking foods containing colours, preservatives and flavours which are not recommended by Feingold's diet plan. Around 51.30% reported in consuming these foods as snacks at least 3 to 4 times per week compared to 7.47% who ate these foods once per week, while 4.87% had it daily. Only 9.09% reported in not consuming foods rich in colours, flavours and

preservatives. All participants who did not respond to the FFQ are mentioned in the NA column in Table 3.

The quality of life of the participants was evaluated using the Weiss Functional Impairment Rating Scale. The rating of the scale in regards to Family, school and social behaviour etc. can be seen in Figure 1. Participants whose mean score were more or equal to 0.5 were rated as highly impaired, those less than 0.5 as mildly impaired and those equal or less than 0.1 as not impaired. Participants who scored Questions assessing family relations revealed 31% had an impairment of more than 0.5 according to the scale rating which referred to a high impairment score, while 50% had mild impairment, less than 0.5 and 10% had no problems or impairment with family relations. Questions assessing functioning in school at two levels; learning and behavioural revealed a high impairment score (43%) in learning at school and 19% each had mild impairment as well as no impairment in terms of learning but when compared to behaviour at school, there were lesser percent of participants having problems. 54% reported no impairment while 32% reported mild impairment and 14% scored more than 0.5, which meant a high score of impairment. Questions relating to life skills showed that a high percent (64%) were highly impaired and 36% were

mildly impaired scoring less than 0.5. When asked about questions relating to their self-concept, only 4% scored more than 0.5, while 46% had no impairment and 27% were mildly impaired. Social activities showed a high impairment score among the participants (54%) compared to those who were not impaired (4%) at all.

Only 31% were seen to be mildly impaired. When asked about getting involved in risky activities, 50% were observed to be mildly impaired while 10% were highly impaired. Surprisingly, 31% had no problems when faced with any risky activities in life.

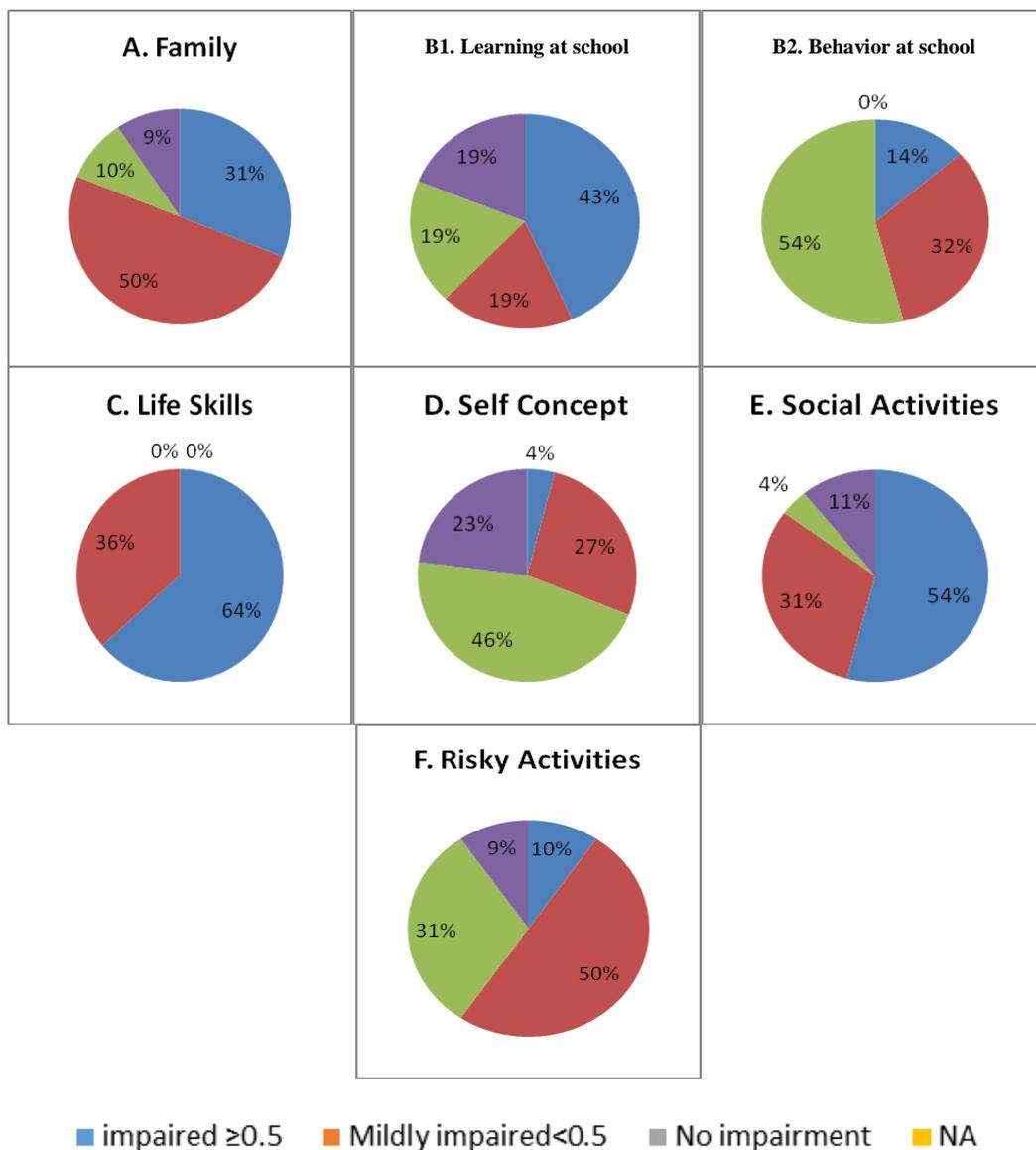


Figure 1. Quality of life for the ADHD children assessed using the Weiss Functional Impairment Rating Scale.

## DISCUSSION

Attention-deficit hyperactivity disorder (ADHD) is the term used to describe children who are inattentive, impulsive, and hyperactive. These behaviours may severely affect school

performance, family relationships, and social interactions. The role of proper nutrition in the behaviour of children has been controversial, but the link of nutritional factors with childhood

behavioural disorders has been continually proposed. [27,28]

This study found that most of the children who took part were overweight (56.75%) as indicated by the CDC growth charts whereas 9.45 % were underweight. A study in 2010 reported the prevalence of overweight, obese and severely obese in all age groups as 23.1%, 9.3% and 2%, respectively, with boys having a significantly higher prevalence of obesity (10.1% vs. 8.4%;  $P < 0.001$ ) and severe obesity (2.3% vs. 1.6%;  $P < 0.001$ ) than girls while girls had a significantly higher prevalence of being overweight (23.8% vs. 22.4%;  $P = 0.014$ ). [29] Although hyperactivity would seem to increase energy expenditure, ADHD appears to increase the risk for being overweight. A study that assessed the body mass index (BMI) in children with ADHD in relation with age and gender concluded that ADHD in boys is a risk factor for being overweight. In girls with ADHD, the prevalence of overweight is age dependent, with the highest risk at 10–12 years. Oppositional behaviours and social communication problems may aggravate this, whereas stereotyped behaviours may be protective. [30]

Dietary assessment among the total number of participants showed that 78.51% of the ADHD children consumed negligible amounts of essential fatty acids which compared with the level of impairment observed in their quality of life. A study reported a greater number of behaviour problems in participants with lower omega-3 fatty acid concentrations along with other symptoms of fatty acid deficiency such as thirst, frequent urination, dandruff, dry skin, and dry hair and children who were supplemented with essential fatty acids showed noticeable improvements in their behavior. [16,31,32] In our study, we observed low consumption of essential fatty acids mainly due to the reason that the subjects are living in a central city. Al-Numair (2005) reported

geographic location has an impact on the consumption of seafood. The consumption patterns for food providing essential fatty acid differ by regions of the country with intakes being higher in the coastal region. [33] Similarly, a higher percent of children with ADHD also consumed low amount of vitamin B complex, and after comparing the level of impairment with the consumption, we see that quality of life being affected in nearly all the children. [27,28] For example, vitamin B6 is an essential homocysteine re-methylation cofactor, and deficiency is associated with increase in blood homocysteine levels. Homocysteine is a risk factor for cerebrovascular disease and may also have directly toxic effects on neurons of the central nervous system. Neuropsychiatric disorders including seizures, migraine, chronic pain and depression have been linked to vitamin B6 deficiency. [34,35] One double-blind study showed behavioural improvement in children with ADHD receiving pyridoxine compared with methylphenidate and placebo. [36] We can assume that the Saudi ADHD children may be suffering to some extent with some of the symptoms because of low intake and looking at the responses on the impairment scale.

Foods rich in salicylates, artificial colours, flavours and preservatives are not recommended by the Feingold's diet for ADHD and autistic children. [37,38] It was seen that food rich in salicylates were poorly consumed by the ADHD participant as these foods are either not always available everywhere or if they are, they are very costly and cannot be afforded by all. On the other hand, food that have artificial flavours, preservatives and colouring agents are consumed more regularly since these foods are cheaper and available in all places.

Studies suggest that ADHD symptoms are related to consumption of colouring agents, simple sugar and preservatives in processed food and

snacks. [39] The food additives and salicylates hypothesis was introduced by Feingold, who proposed that food additives, specifically synthetic food colours and flavours, and naturally occurring salicylates were responsible for hyperactive behaviour in some children. [40] The diet requires children to eliminate all artificial colours and flavours as well as all foods containing salicylates. Feingold reported that as many as 50% of hyperactive children who carefully followed his regimen responded favourably. [16] This diet is based on the theory that many children are sensitive to dietary salicylates and artificially added colours, flavours, and preservatives, and that eliminating the offending substances from the diet could improve learning and behavioural problems. [22] According to the Feingold diet, foods to be avoided include apples, grapes, luncheon meats, sausage, hot dogs, and cold drinks containing artificial flavours and colouring agents. Foods permitted include grapefruit, pears, pineapple, and bananas, beef and lamb, plain bread, selected cereals, milk, eggs, and vitamins free of colouring. [41] Another study in the UK shows that, artificial colours or a sodium benzoate preservative (or both) in the diet result in increased hyperactivity in 3-year-old and 8-9-year-old children in the general population. [42] Despite a few positive studies, most controlled studies do not support this hypothesis. The exact proportion of children with ADHD who have food sensitivities has not been established, and it is believed to be a very small subset of children. [22,42]

The participants in this study were evaluated using a very basic food frequency questionnaire, which showed them not taking enough essential fatty acids and vitamin B complex rich foods but were taking foods rich in artificial flavours, preservatives and colouring which could be the reason for the high percent of impairment seen. Not taking

foods rich in salicylates due to high costs or non-availability has worked in the favour of these children since they are kept away from the side effects of these foods in these children.

In conclusion, there was no awareness among the caretakers for the ADHD children regarding a proper diet plan as recommended by Feingold. Impairment in the quality of life was seen in a higher percent of participants. Awareness programs among the general population in regards to dealing with ADHD with the help of diet plans (eg, Feingold's diet) and its effects on quality of life should be held. A more detailed food frequency questionnaire should be used in further studies among a larger group of ADHD participants and measure the correlation with the impairment in quality of life.

#### ***Ethical approval***

The study was approved by the IRB and ethics committee of the College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia.

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