ORIGINAL ARTICLE **Mirror of Research in Veterinary Sciences and Animals MRVSA/ Open Access DOAJ**

Assessing cow health condition by using the recent Cowdition Smartphone App and its correlation with vital clinical parameters

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ARTICLE INFO
Received: 05.09.2017
Revised: 30 .09. 2017
Accepted: 18.11. 2017
Publish online: 09.12.2017

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Highly productive milk cows suffer from increasing loss in body condition at early lactation, and are more prone to metabolic disorders. Recent Cowdition smartphone application has the ability to determine animal health situation and it is called body condition scoring (BCS) system. It can apply adequately for proper farming and management the animal performance. BCS is also helping to assure that all stages of annual cow cycle are in a good condition. Consequently, appropriate dietary changes can be done to prevent any deficiencies and metabolic diseases. Routinely, rectal body temperature and pulsation and respiratory rates are measured as suitable vital indicators for evaluation the health of the animals and recognize the clinical abnormalities. Therefore, this study intends to correlate between the animal body condition and vital physiological parameters measurements to assess cow health. A total of 30 cows at different stages of the reproduction period, raised at different farms location in Al Muthanna Governorate/ Iraq was nominated animal material of the present study. For each cow, Bayer smartphone Application/ BCS Cowdition was used to measure the body condition, and at the same time, body temperature and pulse and respiratory rates were also measured. Scores that collected from the Cowdition application system were compared with physiological vital indicators parameters. The overall means of BCS were found as 3.9 ± 0.068 and range from 2.5 to 5 for minimum and maximum values respectively. Moreover, 63.33 % (19 out of 30) cows showed the standard BCS ranged between 3.25-3.75 and revealed typical vital clinical parameters. Also, 30% (9 out of 30) cows showed fat BCS values ranged between 4- 4.25 accompanied with variation in the vital clinical parameters that increase with high BCS values. Only 6.66% (2 out of 30) cows showed extremist BCS values which were 2.5 and 5 for poor (emaciated) and grossly fat cow respectively. Moreover, these cows showed also variations in the vital clinical parameters. In conclusion, this study represented for the first time in Iraq the adoption of smartphone BCS Cowdition system to evaluate the animal health. Besides, to understand the relationship between BCS and physiological vital clinical parameters values (body temperature, pulse and respiratory rates), to evaluate and assess the cow body health that helps in the improving of animal nutrition and avoid the metabolic diseases that commonly occur in the highly productive cow. The authors recommend another future study that uses BCS Cowdition Smartphone Appication and correlates it with the animal's metabolic diseases.

To cite this article: Al Salihi K A; Mayaseen T. AbedAlamer; Asaad F. Khalaf. (2017). Assessing cow health condition by using the recent Cowdition Smartphone App and its correlation with vital clinical parameters. MRVSA. 6; (2): 39-49.
DOI: 10.22428/mrvsa. 2307-8073.2016. 00624.x

Key words: Body condition score, cow, BCS Cowdition Smartphone App, Iraq.

Introduction

Body condition is a term used to determine the quantity of stored energy that cow has it for future use. BCS has ability to indicate the energy balance and appreciate the production and reproductive performance. Body condition is affected on both cow and calf functions. It impacts production, breeding, well-being, and duration of dairy livestock. Slimness or obesity can be an evidence to motivating dietetic insufficiencies, health problems, or improper herd management. If done on a regular basis, body condition scoring can be used to troubleshoot problems and improve the health, longevity, and productivity of the dairy herd (Kunkle., *et al* 1998; Roche *et al.,* 2007). Most research display that body condition drops at a faster rate than mass loss. Therefore, body condition scoring can evaluate the possibility of re- producing (Roche *et al.,* 2007; Roche *et al.,* 2013). Over-conditioning, or fatness, may result from poor nutrition or reproduction management. A fat cow is more susceptible to metabolic problems and infections, and is more likely to have difficulty at and after calving. The over-conditioning usually begins during the last three to four months of lactation, when milk production has decreased, but dietary energy and total nutrient levels have not been reduced accordingly. Other common causes of over-conditioning are prolonged dry periods or overfeeding during the dry period (Roche *et al.,* 2013). However, below-acclimatizing, or skinniness, can frequently lesser output and milk fat concentrations because of inadequate energy and protein store to sustain production. Skinny cows commonly do not display heat or conceive until they start to recover or at least preserve their body weight. In nurturing these animals, attention must be taken to preserve production, while raise body reserves. In addition, body condition scoring also acts as a useful tool in dairy heifer feeding management. Skinny heifers probable no develop speedily enough to reach sexual maturity by 11 to 13 months of age. They may also be too small to calve at 22 to 24 months or to transmit enough weight to conserve an ordinary primary lactation production (Huseyin and Zahid, 2015; Hoedemaker *et al.,* 2009). Moreover, fat heifers have been shown to be hard to breed, and if fat when they are close to calving, have difficult calving and produce less milk, when they enter the milking herd, especially if they have been fat at sexual maturity.

Body condition scoring is a vital method that offer an important value for the complications occur from disturbances in the body energy reserves and lead to develop several metabolic disease and reproductive traits (Roche *et al.,* 2013; Edmonson *et al.,* 1989). Diverse approaches are usually used globally to estimate the body condition score. The "6"point scoring system used by Lowman *et al.,* (1976) that extended between "0" and "5". Another body condition system developed by Whitman (1975) with "9" point system. Later on, Holmes *et al.,* (1987) developed body condition score of "10" points. Variations in the body condition scoring system are recognized and occur depending on the country and the animal to be score. The more practiced system in Australia is "8" point system which developed by Earle (1976). Meanwhile, New Zealand (Grainger and Mcgowan, 1982), while, USA, Canada and European Union have used "10", "1-9" and "1-5" by "0.5 steps" respectively.

Recently, BCS Cowdition smartphone application has developed to improve simple and precision body condition scoring for dairy cows. It is a photographic and credible estimation of body fat reserves using a 5-point scale with 0.25-point increments. The scores are a subsidiary evaluation of energy equilibrium. A score of 1 means an actual skinny cow, while 5 means an extremely fat cow, and 3 is an average body condition. Estimation emphases on

the rump (Hind quarters) and loin (flank); scales used in allocating BCS are appeared in Figure. (1).

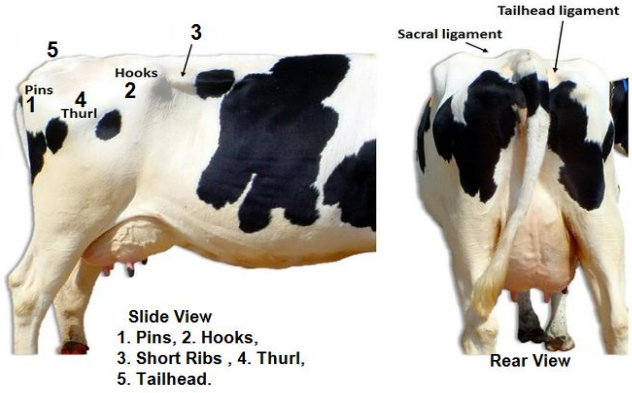

Figure.1: shows the animal view that use for BCS evaluation

The body temperature of the animal is the result of the internal equilibrium between the heat production (the basic metabolism and muscular activities of the body) and heat lost from the body (Jeffrey and Michael, 2010). Pulsation and heart rates and rectal temperature are used as consistent indexes of short period physical stressful in livestock (Plyaschenko and Sidorov, 1987; Verstegen, 1987; Oladimeji *et al., 1996*; Ayo et al., 1998).

Iraq is a distinct core for best common farm livestock species and has a large numbers varieties of farm animal species. According to 1978 estimation survey, there were 1.7 million cattle and 170.000 buffalo (Al salihi, 2012). However, this numbers were increased according to 2009 FAO data estimation that revealed 1.6 million cattle and 275 000 buffaloes (http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Iraq/Iraq.html).

Review of literatures revealed no published BCS for Iraqi cattle or buffalo. In Iraq, there are different species and breeds of cattle, some are local, cross and imported. The estimation of body condition in Iraqi farm cattle are necessary to evaluate its reproduction annual cycle and to design the nutritional program to prevent the most important metabolic diseases. Consequently, this study intends for the first time in Iraq, to implement BCS Cowdition smartphone application to measure the cow body condition and to correlate its scores with vital parameters measurements to assess cow health.

Materials and methods

Cows

This study conducted at different locations in Al Muthanna governorate/ Iraq. A total of 30 cow randomly selected, were used in this evaluation and considered as animal material of this study. The cows were in different stages of annual reproduction cycle.

Technique

Each cow of the animal material was left to rest and acclimatized for short time before evaluation. The body temperature and pulse and respiratory rates were also measured and

recorded. Bayer smartphone Application/ BCS Cowdition was acquired to measure the body condition (Figure. 2). The cow was photographed from both side and rear views. Moreover, all data regarding each cow was inserted in the program including: cow number or name; date of birth; Herd; Breed and Calving date and history. Later on, the program system was requested to analyze all data in order to identify the cow's BCS. Scores that collected from the Cowdition application system were compared with vital indicators parameters.

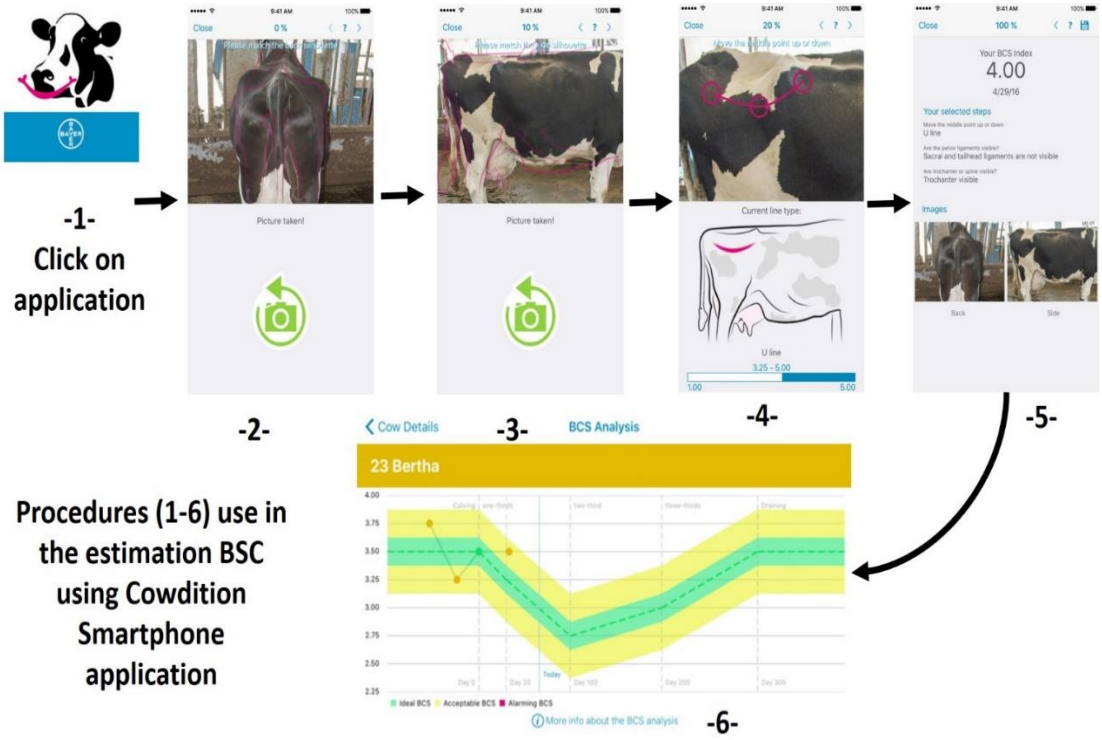

Figure. 2: Shows the procedures use in the estimation of cow's BCS using Bayer smartphone Application/ BCS Cowdition system

Results

The overall means of BCS were 3.9 ±0.068 and range from 2.5 to 5 for minimum and maximum values respectively (Table 1 & Figure 3 A&B). Moreover, 19 out of 30 cows showed the standard BCS ranged between 3.25-3.75 and revealed typical vital clinical parameters (Figure. 4). Also, 9 out of 30 cows showed medium BCS values ranged between 4- 4.25 accompanied with variation in the vital clinical parameters that increase with high BCS values (Figure.5). Only 2 out of 30 cows showed extremist BCS values which were 2.5 and 5 for emaciated and fat cow respectively (Figure. 6). Moreover, these cows showed also variation in the vital clinical parameters (Figure.7).

Table.1: Shows BCS, Temperature, Pulsation and respiratory rates of the cows nominated for measurement their body condition.

No	BCS	Temperature	Respiration	pulse	Photo
1	**3,5**	37.8	24	81	
2	3,5	38.4	24	60	
3	3,25	38.8	27	45	
4	4,25	38.9	21	65	
5	3,25	37.3	33	43	
6	**5**	37.6	40	56	
7	4,5	36.8	20	58	
8	3,75	37.8	29	50	
9	3,5	39	50	34	
10	4,25	38	28	61	
11	3,5	38.5	35	64	
12	3,25	37	25	76	
13	3,5	38.7	28	65	
14	3,5	36.6	23	62	
15	4	37.4	32	53	
16	**2,5**	37.2	24	76	
17	4	39.6	38	68	
18	3,5	39.1	75	84	
19	3,5	38.5	22	69	
20	3,5	36.6	31	55	
21	3,75	37.2	43	68	
22	**4,5**	37.8	21	46	
23	3.5	38.1	26	78	
24	3.5	37.6	33	67	
25	4.25	37	44	34	
26	3.75	37.8	28	58	
27	4	39.1	32	41	
28	3.5	38.3	60	66	
29	3.75	38.6	43	56	
30	4.25	37.5	78	69	
Average	3.9	37.9	34.5	59.9	

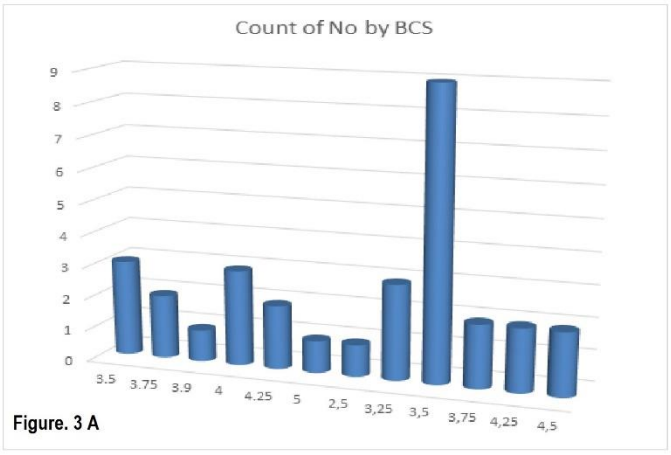

Figure. 3 A

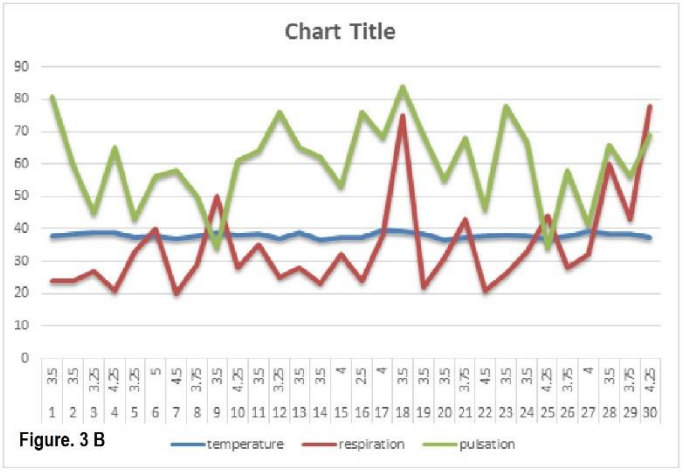

Figure. 3 B

Figure. 3: A; Shows the distribution of cows according to BCS, B. The correlation between the body condition scores and the physiological vital indicators

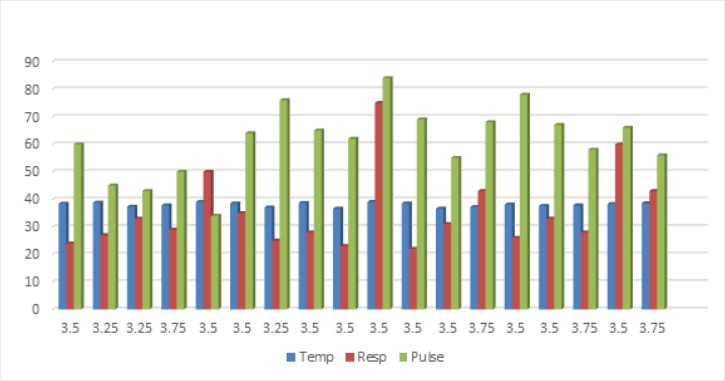

Figure. 4: Shows the distribution of body condition in relation to physiological vital clinical indicators for the group with good BCS

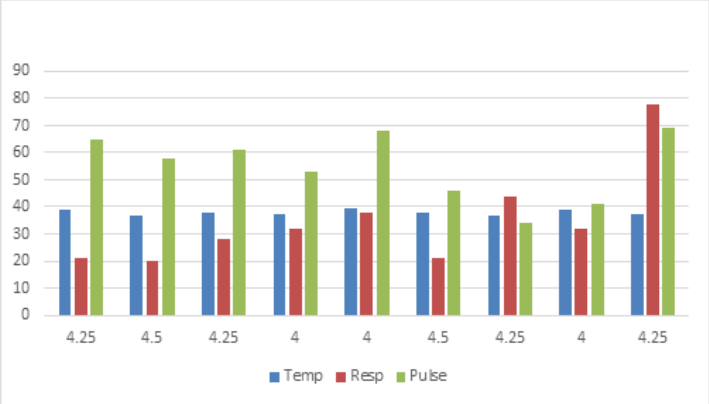

Figure. 5: Shows the distribution of body condition in relation to physiological vital clinical indicators for the group with Fat BCS

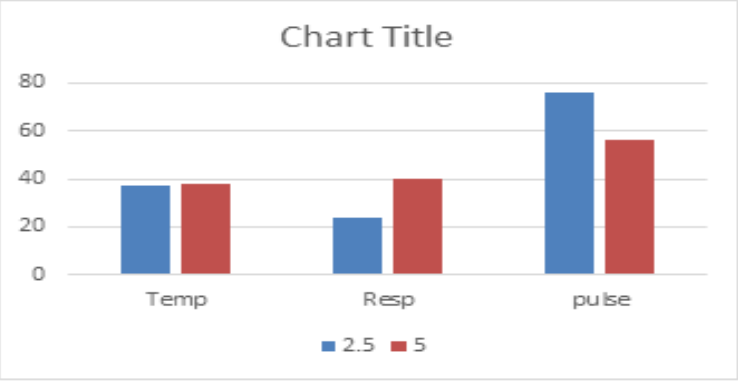

Figure. 6: Shows the distribution of body condition in relation to physiological vital clinical indicators for the group with grossly fat BCS

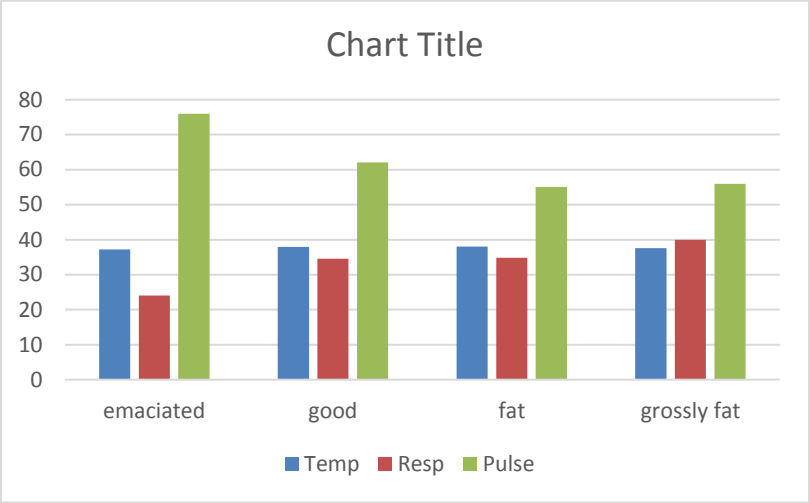

Figure. 7: Shows the variation in the physiological vital signs parameters between different BCS groups

Discussion

Body condition scoring (BCS) system has ability to distinguish the alterations in the dietary requirements for a cow in the flock. BCS is a numeric scoring system that use to assess body energy reserve in the cow. A strong relationship was approved by research between cow reproductive performance and her body condition (Deniz, 2016; Bayer HealthCare, 2014; Roche *et al.*, 2007; Berry *et al., 2007*). Observing body condition using BCS system is an essential professional methods for defect the productivity failure and then able to take a rapid action to correct it (John *et al.*, 2009). The results of the current study revealed that the whole means of cows BCS was 3.9 ± 0.068. Moreover, 63.33 % (19 out of 30) of cows showed the standard BCS ranged between 3.25-3.75 and shown typical vital clinical parameters. These results are located within the range of good BCS that ranged between (3-4), according to Bayar company that released and created the Cowdition system.

According to Bayer interpretation, the cow that reveal the score (3-4), these scores means good BCS. The cow in this score reveal Tail head with fat cover over whole area and skin smooth but pelvis can be felt. Moreover, Loin, end of horizontal process can only be felt with pressure and only slight depression in loin. These results are compatible with results previously reported worldwide by other research on cow BCS (Roche *et al.*, 2004; Bewley &Schutz., 2008; Bewley *et al.*, 2010; Battiato *et al.*, 2010).

The result of this study also showed a number of cows that located within the medium body condition scores. There were 30% (9 out of 30) of cows showed fat BCS values ranged between 4- 4.25 accompanied with variation in the vital clinical parameters that increase with high BCS values. According to Bayer interpretation, these scores (4-5), means fat BCS, which the cow revealed Tail head – completely filled and folds and patches of fat evident. Moreover, the Loin – cannot feel processes and will have completely rounded appearance. Only 6.66% (2 out of 30) cows showed extremist BCS value. These extremist BCS were 2.5 and 5 for emaciated and grossly fat cow respectively. Moreover, these cows showed also variation in the

vital clinical parameters. And according to Bayer interpretation the score 2.5 is located at the moderate body condition, where the cow reveal the Tail head – shallow cavity but pin bones prominent; some fat under skin and Skin supple. While, Loin – horizontal processes can be identified individually with ends rounded. These results are in agreement with records of other research (Sablik *et al.,* 2014; Soares and Dryden, 2011). Moreover, some research (Vasseur *et al.,* 2013; Alic, 2012) found that BCS < 2.5 and 4.0 > BCS of cows is highly diminishing the animal well-being. These variations of BCS may initiate from different reasons such as dietary levels and well planned ration. Nonetheless, these BCS alteration and conversion of animal tissues occur in highly productivity.

It is worth to mention the body condition target scores during different stages of cow's annual reproduction cycle. There are acceptable BCS (Table. 2) for each stages (Bayer Health Care, 2015). The variations in BCS are to be likely as a cow pass via the steps of milk production (lactation) and pregnancy. Majorities of cows revealed decline BCS from calving and around the first100 days of milk production, later on rises over dry-off. Only scarce proficient, high producing cows may not practice huge variations in BCS, and some incompetent, low producing cows may constantly rise in BCS over a lactation. However, when cows collect too much or too little condition or alterations occur too rapidly, well-being and performance can be affected.

Table. 2: Shows the suggested target BCS during different stages of lactation

Suggested Body Condition Scores for Cows by Stage of Lactation.				
Stage of Lactation	**DIM**	**BCS Goal**	**BCS Min**	**BCS Max**
Calving	0	3.50	3.25	3.75
Early Lactation	1 to 30	3.00	2.75	3.25
Peak Milk	31 to 100	2.75	2.50	3.00
Mid Lactation	101 to 200	3.00	2.75	3.25
Late Lactation	201 to 300	3.25	3.00	3.75
Dry Off	> 300	3.50	3.25	3.75
Dry	- 60 to -1	3.50	3.25	3.75

The results of the current study also showed a good relationship between the BCS and the vital normal physiological signs. The average of body temperature, pulse rate and respiratory rate were 37.9, 34.6 and 62.1 respectively for the majority (63.33%) of animal study that revealed 3.25-3.75 BCS. Moreover, the averages of these physiological parameters were 38.01, 34.1 and 55 for temperature, respiratory rate and pulse rate respectively for the study animals that showed 4- 4.25 BCS. However, the physiological parameter for the cows with low 2.5 and high 5.0 BCS values were 37.2, 37.6; 24, 40 and 76, 56 for temperature, respiratory rate and pulsation rate respectively. Although no variation appeared between different BCS in regard to the body temperature, variations were seen in pulsation and respiratory rates. These results are in agreement with Kubkomawa *et al.,* (2015) who mentioned that poor body condition score also affect rectal temperature, respiratory, pulse and heart rates. It is also related with

cheap income per cow, elevation in the postpartum pause, pathetic calves at birth, low value and capacity of colostrum, low milk production, high incidence of dystocia, and lesser weaning masses. The correlation among BCS and health difficulties have frequently described inconsistent results in different investigation studies. The threat of different health problems such as metritis has a tendency to be amplified in cattle with low BCS or those that drop body condition throughout the dry period. Moreover, these cows may have raised threat of dystocia (Grainger and McGowan, 1982).

In conclusion, this study offered for the first time in Iraq the adoption of smartphone BCS Cowdition application to evaluate the animal health. Besides, to understand the relationship between BCS and vital clinical parameters values (body temperature, pulse and respiratory rates), to evaluate and assess the cow body health that helps in the improving the animal nutrition and avoid the metabolic diseases that commonly occur in the highly productive cow. The authors recommend another future study that uses BCS Cowdition Smartphone App and correlates it with the animal's metabolic diseases.

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