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Case report

Guinness World Record: Personal Experience and Physiological Responses of a Non-Professional Athlete Successfully Covering 620 Km in 7-Days by Foot Across the United Arab Emirates

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Abstract
Ultra-endurance record-breaking attempts place significant metabolic, cardiovascular, and mechanical stress on the athlete. This research explores the personal experience and physiological responses of a non-professional athlete attempting the Guinness World Record of covering 620 km on foot across the United Arab Emirates in 7-days or less. The participant wore a smartwatch throughout the challenge to collect heart rate, activity, and environmental temperature data. Anthropometric, body composition, and inflammatory, haematological, and endocrine biomarkers measurements were completed pre- and post-event. A pre- and post-event interview was conducted to collect data on training and preparation, and self-reported experiences during the challenge. Despite episodes of diarrhoea, vomiting, and muscle cramps due to hypohydration during the first days of the challenge, the participant successfully completed 619.01 km in six days, 21 hours, and 47 minutes (average pace 10.11 min/km) achieving a new Guinness World Record. Body mass remained unchanged, fat mass decreased, and fat-free mass especially in the legs increased over the seven days, most likely due to water retention. Biomarkers of stress, cell damage, and inflammation increased. Haematological markers related to red blood cells decreased probably due to exercise-induced increases in plasma volume with the participant classified with mild anaemia post-event. This case study reinforces the importance of amateur athletes attempting similar ultra-endurance events adhering to a pre-planned hydration and nutrition strategy to maximise performance and minimise the risk of injury.

Key words: Guinness World Record, United Arab Emirates, Ultra-marathon, physiological response, personal experience, case report.

Introduction

Motivated only by becoming a Guinness World Record holder, and with no financial incentive, a non-professional athlete set off on 02 March 2021 to try and break the Guinness World record for one of the toughest ultra-endurance challenges in the United Arab Emirates (UAE) i.e. covering 620 km on foot across the UAE in 7-days or less. The term ultra-endurance is used to categorize endurance events exceeding six hours (Zaryski and Smith, 2005) and notably encompasses ultra-distance running, cycling, swimming, cross-country skiing, and ultra-triathlon (Scheer, 2019). Indeed, ultramarathons, which include running or walking events longer than 42.195 km (Knechtle, 2012), have gained increasing popularity in recent years (Cejka et al., 2014). However, ultra-endurance events, especially those attempting to break a time bound world record, place significant physiological (e.g., metabolic, cardiovascular), mechanical, and psychological stress on the athlete. Participation in prolonged bouts of physical exertion, particularly over several days, can lead to important changes in body composition and metabolism, fluid and electrolyte equilibrium, haematologic parameters, immune system function, and musculoskeletal and bone health (Knechtle and Nikolaidis, 2018). The aim of the study was to assess the personal experience and physiological responses of a non-professional athlete attempting the Guinness World Record of covering 620 km on foot across the UAE in 7-days or less.

Methods

Guinness World Record – The challenge
The Guinness World Record attempt consisted of crossing the seven Emirates that comprises the United Arab Emirates (UAE) by foot in 7 days or less. The record was previously attempted in 2017 by a male Emirati athlete who covered the total distance in 14 days (Gupta, 2017). The 620 km route, started at the Saudi border and followed the highway along the coast, through Abu Dhabi, Dubai, Sharjah, Ajman to Umm Al Quwain. It then crossed from the Arabian Gulf to the Gulf of Oman, passing through Ras Al-Khaimah, before traversing the Hajar mountain range to finally finish on the beach in Fujairah (Figure 1). To achieve his goal, the participant planned to alternate between running and walking in shifts of 8 active hours and 4 resting hours. Resting time was planned to be spent relaxing or sleeping in a support vehicle. Apart from fluid, energy gels, a mobile phone, and activity trackers, the participant did not carry any extra items. Food was provided during the resting time by the support team along the challenge.

Design and methodology
This observational study was designed to explore the personal experience and physiological responses of a non-professional athlete successfully attempting a Guinness World Record. The study design is shown in Figure 2 and data was collected before, during, and after the event (Table 1). In addition to quantitative measures, the participant was also interviewed before and after the event.

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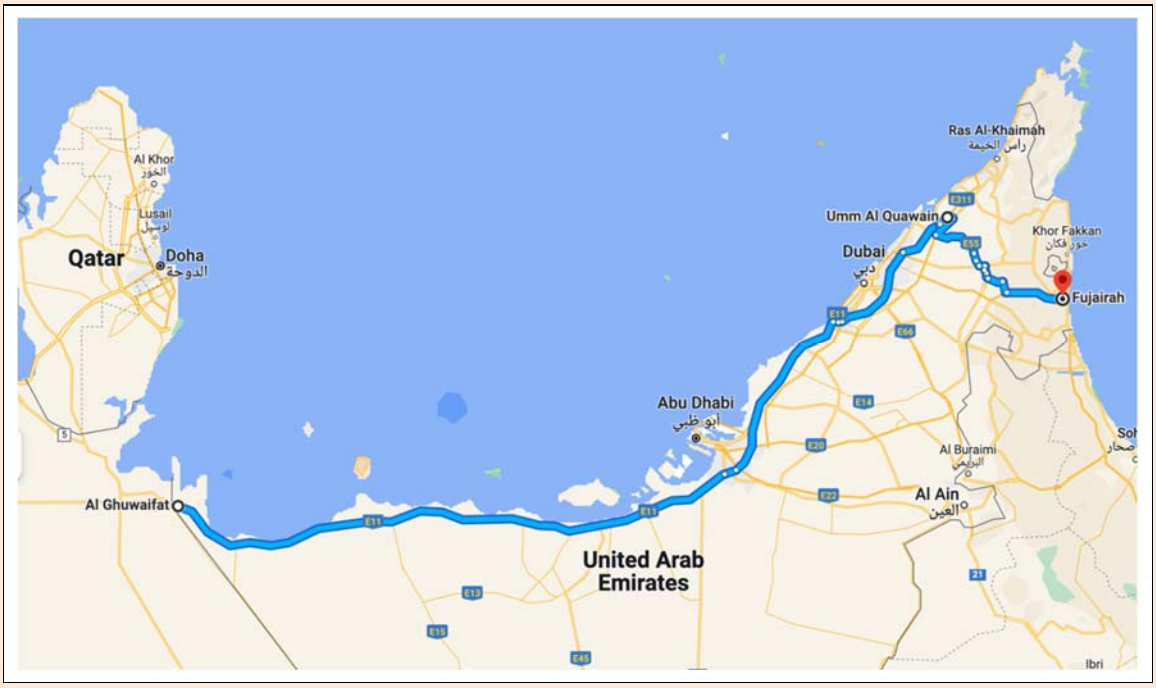

Figure 1. **The 620km route (blue line) across the seven emirates of the UAE, starting on the most western border of Abu Dhabi and ending on the beach in Fujairah.**

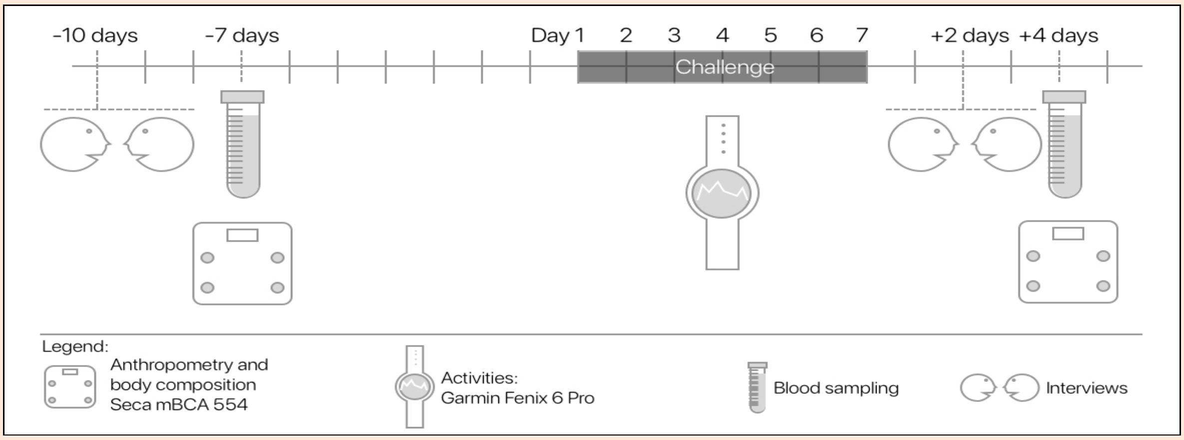

Figure 2. **Study design and data collection points.**

Table 1. **Overview of data collection pre-, during, and post-challenge.**

When		What	How
Pre-Event	**-10 days**	Participant and challenges presentation	Structured interview
	-7 days	Body composition	Seca mBCA 554 (Germany)
	-7 days	Immunology, clinical chemistry, hematology, endocrinology	Standard clinical chemistry and Immunology medical laboratory tests
During the Event		Distance, duration, pace, elevation, energy expenditure, heart rate	Garmin Fenix 6 Pro Solar (Switzerland)
Post-Event	**+2 days**	Retrospective diary	Semi-structured interview
	+4 days	Immunology, clinical chemistry, hematology, endocrinology	Blood test
	+4 days	Body composition	Seca mBCA 554 (Germany)

During the first interview (10 days pre-event), the participant discussed the record attempt, training plan for the preceding nine months, and the diet he intended to follow during the challenge. A second interview took place after the challenge (2 days post-event) during which he retrospectively described his journey on a day-by-day basis.

Subject

The participant, a 34-year-old British male, is a full-time employee and avid non-professional athlete with a body mass index (BMI) of 26.79 kg/m^2 (weight: 88.75 kg, height: 1.82 m, body type: mesomorphic). He comes from a background of participating in and practicing multiple sports, including circuit and high-intensity training. In the years leading up to the record attempt he had also participated in other endurance challenges including climbing Mount Kilimanjaro in 2018, the Bosphorus Cross Continental race (i.e., 6.5 km ocean swim) in 2019, and the completion of running three marathons in a single day in 2020. However, he only started running under the supervision of a coach from September 2019, and training for the attempt started 9-12 months prior to the event, running 5-6 hours per week (40-50 km per week at a pace of 8-10 km/h). Six to nine months prior to the event, he gradually increased his running volume to 10 hours per week (80-100 km per week at a pace of 8-10 km/h). During the final six months preceding the event the athlete maintained a running schedule of 15 hours per week (125-150 km at a pace of 8-10 km/h) before he injured his hip flexor, which immobilized him for the entire month of December 2020. He gradually went back to training during January and February 2021, focusing on long walks of up to 14 hours (2 shifts of 7 hours with a 2-hour break in-between) for a total 75-150 km per month at a pace of 5-7 km/hour, prior to embarking on the attempt in March 2021.

Anthropometry and body composition

Anthropometric and body composition measurements were made using a medical body composition analyzer (Seca mBCA 554, Hamburg, Germany) and height measuring board by trained data collectors. Body mass (kg) and height (m) were measured with the participant in light clothing using standard protocols. Body mass index (BMI; kg/m^2) was calculated by dividing body mass (kg) by the square of height (m). Bioelectrical impedance was used to assess the following body composition parameters: total fat mass (kg; %), total fat-free mass (FFM; kg; %), skeletal muscle mass (kg), right arm FFM (kg), left arm FFM (kg), right leg FFM (kg), left leg FFM (kg), torso FFM (kg), total body water (L; %), and extracellular water (L; %).

Blood sampling

Venous blood was collected from the median antecubital vein to assess a range of biomarkers including complete blood count, free thyroxine, thyroid stimulating hormone, serum electrolyte panel, and high sensitivity c-reactive protein.

Activities

A Garmin Fenix 6 Pro multisport global positioning satellite smartwatch was worn on the right wrist by the participant throughout the challenge to collect data on heart rate (beats per min), time (hours:minutes), distance (km), speed (km/h), elevation gain/loss (m), energy expenditure (cal), and environmental temperature (°C).

Semi-structured interviews

A semi-structured interview was conducted pre- (10 days before) and post-challenge (2 days after). The pre-challenge interview aimed to collect data with regards to the preparation for the challenge and the description of the challenge, while the post-challenge interview focused on the challenge itself. The participant was asked to describe each day of the challenge from a physical, mental, and nutritional perspective and highlight challenges as well as any unexpected experiences.

Results

The participant successfully completed 619.01 km distance across the seven Emirates of the UAE in six days, 21 hours, and 47 minutes (active time 104 hours 27 minutes, and 38 seconds), achieving a new Guinness World Record at an average pace of 10.11 min/km (Table 2). The athlete divided the challenge into 15 shifts over the seven days with a mean shift duration of 7 hours and 50 minutes covering ~41 km per shift (Table 3). Figures 3a and 3b show that the athlete completed the first three shifts at a faster than expected pace and covered a greater distance than planned, leading to a slower pace from shifts 4 to 15. On average, the athlete expended 3112 calories per shift and approximately 75 calories per km throughout the seven-day challenge (Table 3).

Body composition

As shown in Table 4 below, body mass remained unchanged during the course of the event, however, body composition changed. This included a 45.3% reduction in fat mass and a 9.6% increase in FFM and skeletal muscle mass (specifically in the legs).

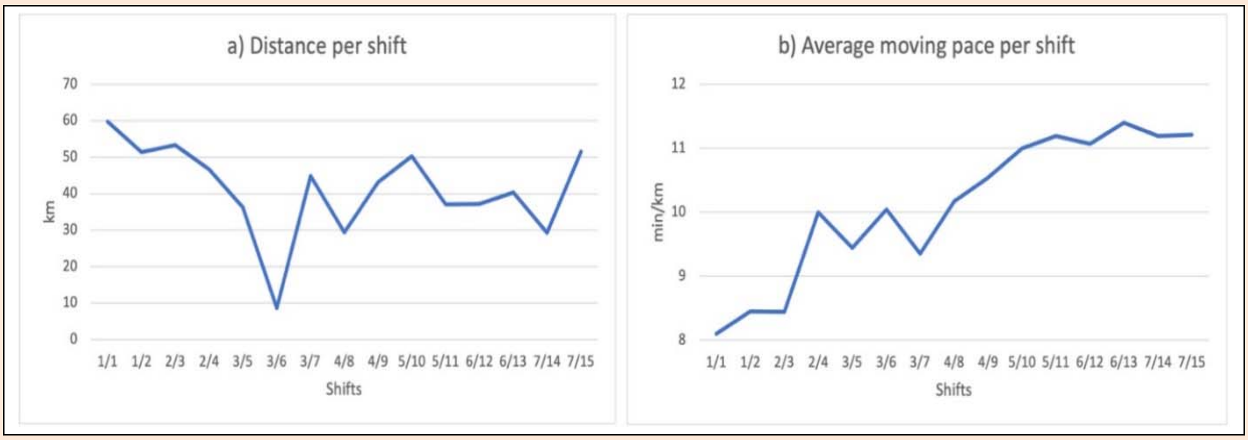

Figure 3. a: Distance per shift, on the right, b: Average moving pace per shift.

Table 2. Qualitative data on the participant's journey integrated with activity data

Day, Time, Date	Activity Data / Participant's Quote
Day 1 – 15:00 02 March 2021 to 23:11 02 March 2021	The participant started faster than planned alternating between approximately 2 km of running (5-5:30 min/km) and 1 km of active walking (8.4 min/km) for the first 25 km. The participant said: "At the beginning I was taking a high sugar sport nutrition, but not as structured as I should have been, and I started to experience stomach pain". The rest of this first shift (5h30min) was interrupted by seven episodes of diarrhoea. The participant took the decision to walk the remainder of the planned 30 km at a pace of 9 min/km. During the break, his pre-planned sport nutrition diet was replaced by plain rice and noodles and some chicken to reduce his abdominal pain and diarrhea. The second shift started with walking for 10 km and then he switched between episodes of intermittent walking and running before finishing with walking for the last 10 km. "I felt mentally frustrated not having followed my racing strategy and dietary plan properly."
Day 2 – 03:09 03 March 2021 to 21:37 03 March 2021	The participant could only sleep 30 minutes during his second resting period of 4 hours. He started off on his next shift walking at a pace of 9 min/km for the first 20 km. The subsequent 3 hours altered between running at 5 min/km for 1 km and walking at 9 min/km for 2 km, before finishing by walking for 10 km at 9.3 min/km. "I felt good running during the majority of the shift, but it broke me [physically] for the second one and most probably the rest of the challenge". After eating rice and chicken noodles, the second block was mostly walking at 9.3 min/km. "My body started to get sore. It started to become mentally difficult as it was misty and pitch black and I could hardly see. I also had no concept of whether I was going uphill or downhill. After a difficult 3 hours, I asked someone from the support team to walk with me as I was mentally struggling."
Day 3 – 22:12 04 March 2021 to 10:37 05 March 2021	The participant could only sleep 90 minutes during his resting time and walked almost for the entire 8-hour shift at 9.4 min/km. "I felt that my body was not following me". After about 36 kms, the participant had to stop due to shin splints, cramps in the legs, and pain in his hip flexors. He received a leg massage from a sport physiotherapist. After a 95-minute break, he ran another 8.68 km at a pace of 10.4 min/km. "I started to realize that I would need to expand my blocks as I was progressing very slow, and I started to physically and mentally break". The shift started 45 mins before the planned time, and he maintained a pace of 9.4 min/km for about 2 hours. This was followed by a 25-minute break. The same sequence was carried over for the rest of the shift. During this shift, the participant was inactive for about one hour.
Day 4 – 18:01 05 March 2021 to 10:03 06 March 2021	The shift was postponed by 2 hours due to authorization issues to walk on the side of the highway. He eventually started at 18:00 instead. It resulted in a rest time of almost 7h30 min. The first 50 mins were walked at a pace of 10 min/km after which a first 10-minute break was taken. "My shin splints and hip flexors were very painful, and every step was a challenge". He restarted at the same pace and continued for about 95 minutes before taking a 30-minute break. He terminated the shift after 5h46min. "I got a short mental boost as I arrived in Abu Dhabi city, but it also meant much busier roads". After a 35-minute break, the participant started his second shift of the day that lasted 9h40min during which he was active for 7h50. The first 25 km were walked at a 10.4 min/km pace, followed by a 45-minute break. The rest of the shift altered walking at 11 min/km with short break every few kms. "I realized that I was not even halfway through the challenge and my body was completely broken, doubting that I could finish as my body would get worse with the days. Mentally, it was certainly my darkest day".
Day 5 – 13:58 06 March 2021 to 10:33 07 March 2021	"Physically, with my shin splints, nothing could have been worse. If the rest of my body seemed to have adapted, my shin splints needed more rest. However, I had a massive mental boost as I arrived in Dubai". The participant walked for 9h12min at 11 min/km within a 10h44min shift. Apart from a 50-minute break, he took 7 small breaks (between 2 to 10 mins each) along the way. After a 2-hour rest only to catch up with time, he started his second shift at a stable speed of 11.1 min/km and took 2 breaks of 15 minutes each. "At the end of the day, the challenge was back on track. I also knew that I would see my wife, which gave me an additional boost."
Day 6 – 14:14 07 March 2021 to 12:45 08 March 2021	For safety reasons – i.e., heavy traffic and construction work on the side of the road - the participant had to continue the journey on smaller roads than originally planned. It included crossing, walking up and down pavements, roundabouts and navigating between cars. As a result, the participant was constrained to stop 25 times in this shift. "Physically, it was the hardest as my body was used to straight, obstacle-free roads". After 6 hours at an 11 min/km pace, he stopped for 40 minutes. "My body completely broke and I could not move". A physiotherapist performed dry needling on his hip flexors and calves. He continued his shift for one hour. After more dry needling during rest time (i.e., 3h40min), the participant set off on an 8h40min shift during which he was active for 7h50min. For the first time, he changed direction (i.e., until now he was walking toward the North and changed direction to the East). He was also faced with having to walk uphill for the entire shift – 175 m elevation gain. However, he was also less interrupted by road crossings and traffic lights. In total he walked 40 km at 11.4 min/km. "When I finished my shift, my support team started to worry as I was not coherent in what I was saying, and they had never seen me like this".
Day 7 – 14:26 08 March 2021 to 12:47 09 March 2021	The participant had 80 km to complete within the remaining 25 hours. "The beginning was hard as I had to walk on the side of a truck road, being buffeted by lorries [passing vehicles creating strong winds] and I felt in much worse physical state at this time. I also knew I would have to walk uphill all along". After about 3 hours, the participant took a 40-minute break. He restarted at the same pace of 11.2 min/km and stopped after 2h30min due to an episode of vomiting. He decided to take his rest shift to recover. After 3h11min of resting, he started his last shift that consisted of completing 51.5 km. He completed the rest of the ascent (258 m) at a pace of 11.1 min/km for about 3h30 hours. "When I reached the top, I had to lie down for 10 minutes as I was completely broken". In total he stayed inactive for 50 minutes and then started his descent towards the finish line at a pace of 11 min/km. "I was limping and could almost not walk anymore but I knew by this point, no matter what happened, I was going to do this". The last 10 km were pain free as "the adrenalin kept me going and I was focused on getting to the sea". About two hours and fifteen minutes before the deadline, the participant crossed the finish line and set the Guinness World Record for the Fastest Crossing of the UAE on Foot.

Table 3. Time, distance, speed, energy expenditure, and elevation data.

Date March 2021	Temp. Min;max; avg °C	Day/ Shift	Shift Duration Total Shift hh:m:ss	Active Time hh:m:ss	Rest Time hh:m:ss	Distance (km)	Mean Pace min/ km	Mean HR, BPM	Calories Burned per Shift, Calories	Calories per km, Cal/km	Elevation Gain, m	Elevation Loss, m	Rest Time between Shifts hh:m:ss
02	25;34;27	1/1	8:47:12	8:07:54	0:39:18	59.79	8.10	126	4899	82	252	297	
03	22;35;27	1/2	8:00:02	7:30:17	0:29:45	51.43	8.45	109	3911	76	168	154	3:13:48
03	25;33;28	2/3	8:03:15	7:45:01	0:18:14	53.27	8.44	107	3943	74	113	128	4:06:58
04	22;37;28	2/4	7:45:59	7:28:42	0:17:17	46.63	9.37	95	3421	73	61	58	3:57:45
04	28;35;31	3/5	6:14:13	5:53:15	0:20:58	36.29	9.44	97	2682	74	51	49	4:28:01
04	27;30;28	3/6	1:29:27	1:27:27	0:02:00	8.68	10.04	98	626	72	10	5	0:34:47
05	21;42;28	3/7	8:14:49	7:10:46	1:04:03	44.91	9.35	91	3235	72	47	50	2:41:33
05	28;34;30	4/8	5:46:30	5:01:51	0:44:39	29.34	10.17	91	2184	74	35	48	7:23:11
06	27;39;30	4/9	9:40:43	7:50:21	1:50:22	43.13	10.54	88	3258	76	109	125	0:35:30
06	24;34;28	5/10	10:44:38	9:12:35	1:32:03	50.22	11.00	86	3773	75	153	122	3:54:17
07	25;39;29	5/11	7:42:42	6:59:01	0:43:41	37.02	11.19	87	2697	73	87	83	2:08:22
07	27;36;29	6/12	8:17:09	6:53:11	1:23:58	37.14	11.07	91	2840	76	137	108	3:40:18
08	21;41;29	6/13	8:40:33	7:51:02	0:49:31	40.35	11.40	87	2935	73	175	117	4:53:51
08	25;40;32	7/14	6:48:05	5:31:36	1:16:29	29.29	11.19	91	2366	81	152	32	3:20:27
09	23;41;29	7/15	11:21:43	9:44:39	1:37:04	51.52	11.21	92	3913	76	325	488	3:11:55
Mean			7:50:28	6:57:51	0:52:37	41.27	10.11	95	3112	75	125	124	3:26:29
Total			117:37:00	104:27:38	13:09:22	619.01			46683		1875	1864	48:10:43

Table 4. Body composition pre- and post-event.

	7 Days Pre-Event	4 Days Post-Event	Change (%)
Body mass (kg)	88.75	88.10	-0.65 (-0.73)
Body mass index (kg/m²)	26.79	26.60	-0.19 (-0.71)
Fat mass in kg and in (%)	16.66 (18.77)	9.12 (10.35)	-7.54 (-45.26)
Fat-free mass in kg and in (%)	72.09 (81.23)	78.98 (89.65)	6.89 (9.56)
Skeletal muscle mass in kg	36.61	39.30	2.69 (7.35)
Right arm in kg	2.58	2.65	0.07 (2.71)
Left arm in kg	2.55	2.53	-0.02 (-0.78)
Right leg in kg	7.19	9.36	2.17 (30.18)
Left leg in kg	7.14	9.44	2.30 (32.21)
Torso	17.16	15.32	-1.84 (-10.72)
Total body water in L and in (%)	53.17 (59.53)	57.76 (65.15)	4.59 (8.63)
Extracellular water in L and in (%)	20.75 (23.23)	23.14 (26.10)	2.39 (11.52)

Blood results

As displayed in Table 5, the baseline blood values measured before the record attempt were all within the normal ranges except for his Red Blood Cell (RBC) count. Before the start of the record attempt the participant had an RBC count of 4.49 $10^6/\mu L$, which is close to the lower reference limit for males (4.3-5.9 $10^6/\mu L$; Dean, 2005). Results from blood samples four days after the event showed that his RBC numbers decreased by 8% and he presented with an RBC count of 4.11 $10^6/\mu L$ which is less than the normal range for men (4.3-5.9 $10^6/\mu L$; Dean, 2005). His haemoglobin before the record attempt (13.4 g/dL) was also slightly below the reference limit for males (13.5-17.5 g/dL; Dean, 2005) and his haemoglobin dropped substantially below normal values (12.2 g/dL; Dean, 2005) post-record attempt. Similarly, his haematocrit (HCT/PCV), a measure of the volume percentage of RBC in blood, also decreased to below the reference range after the record attempt (36%; range: 39-52%). These haematological changes were also accompanied by a 74% reduction in iron (pre: 28.9 umol/L vs. post: 7.4 umol/L) ending up with iron levels much lower than the normal range for men (11.6-31.3 umol/L). The only other parameter that fell below the normal range was free testosterone which was measured at 4.55 pg/ml (normal range 4.81-22.42 pg/ml) post event, signifying a 49% reduction from before the record attempt. Total testosterone also fell but remained within the reference range; however, free testosterone is more biologically relevant.

Two parameters, namely C-reactive protein (CRP) and bicarbonate were measured to be above the normal range post event. His CRP values increased significantly (nearly 3000% increase) to 30.8mg/L (normal range: 0-5mg/L), while his bicarbonate levels were slightly above the normal range (22-29 µmol/L) after the record attempt, moving from 27 to 30 µmol/L.

Despite remaining within the normal reference range, a number of other blood parameters underwent more than 25% changes over the course of the event. These include Ferritin (-102%), Thyroid stimulating hormone (-42%), white cell count (+29%), platelet count (+60%), Neutrophils (+39%), Eosinophils (+200%), Basophils (+89%), free testosterone (-49%), and total testosterone (-33%).

Discussion

The participant successfully completed the 620 km route across the seven Emirates of the UAE in seven days achieving a new Guinness World Record at an average moving pace of 10.11 min/km. The participant had planned to follow a strict walking pace throughout the challenge to ensure he completed each stage and the entire distance within the planned time whilst minimizing the risk of injury, which could end the challenge prematurely. Although speed and distance travelled during each shift would be expected to vary slightly with changes in the elevation, ambient environmental temperature, and fatigue; there was no consistent pattern in the participant's walking pace. Indeed, the participant completed the first three shifts at a faster pace than originally planned and this subsequently led to the lower limb musculoskeletal pain and fatigue that was reported in the first half of the challenge. Moreover, the participant deviated from the planned nutritional strategy and instead his high glucose intake led to gastrointestinal pain and diarrhea. These observations reinforce the importance of adhering to a pre-planned hydration and nutrition strategy and training the gastrointestinal tract to tolerate high glucose intakes (Jeukendrup and McLaughlin, 2011; Jeukendrup, 2017). In contrast, a recent case study of an experienced male ultra-endurance walker (age 41 years; mass 69 kg; height 173 cm) who used the Nordic walking technique (i.e. a form of fast walking with two poles) and pacing strategy to break the "Longest Marathon Nordic Walking" Guinness World Record covering 274 km in 70 hours on a regular 400 m running track (Pedrinolla et al., 2017). The study showed the Nordic walker was able to maintain a consistent pace of 4.8 ± 1.1 km/h for 70 hours and this was achieved by successfully managing his metabolic energy, oxidative stress, and psychological state (Pedrinolla et al., 2017).

It is not uncommon for ultra-endurance competitors, especially in running-based events, to experience changes in body composition including a reduction in body mass due to an energy deficit caused by energy expenditure exceeding energy intake (Knechtle and Nikolaidis, 2018). In our study, there was a minimal reduction in body mass (-0.7%) but it is unclear whether the athlete was able to balance feeding with energy demands throughout the record attempt due to a lack of repeated body mass measurements. However, his post-record attempt body mass suggests he was able to replenish glycogen stores and re-balance hydration in the first few days of recovery. The athlete experienced a reduction in fat mass (-45.3%) and relative increase in FFM (9.6%) which was predominantly observed in the legs and most likely due to water retention in skeletal muscle. Knechtle and Kohle (2007) have suggested that changes in body and skeletal muscle mass during ultra-endurance events might be relative changes due to fluid retention and that future studies should employ suitable methods to detect variations in hydration status and water metabolism.

Table 5. Blood test results pre- and post-event.

Measure	Units	Range	Before	After	Changes Absolute (%)
Ferritin	ng/mL	21.81-274.66	51.6	104.05	52.45 (102)
Creatine Kinase (MB fraction)	ug/L	0-3.5	1.71	3.09	1.38 (81)
C-Reactive Protein	mg/L	0-5	<1	30.8	x30 (2980)
Iron (Fe++)	umol/L	11.6-31.3	28.9	7.4	-21.5 (-74)
Bicarbonate (HCO3 -)	mmol/L	22-29	27	30	3 (11)
Chloride (Cl)	mmol/L	98-107	104	101	-3 (-3)
Potassium (K)	mmol/L	3.5-5.1	4.4	4.7	0.3 (7)
Sodium (Na)	mmol/L	136-145	141	139	-2 (-1)
Free T4 (Free Thyroxine)	pmol/L	9-19.04	12.12	13.72	1.6 (13)
Thyroid Stimulating Hormone	uIU/mL	0.35-4.94	2.1357	1.2428	-0.8929 (-42)
White Cell Count	103/uL	4-11	5.6	7.2	1.6 (29)
Red Cell Count	106/uL	4.5-5.9	4.49	4.11	-0.38 (-8)
Haemoglobin	g/dL	13-17.5	13.4	12.2	-1.2 (-9)
HCT (PCV)	%	39-52	39.4	36	-3.4 (-9)
MCV	fL	80-100	87.7	87.7	0 (0)
MCH	pg	26-34	29.8	29.7	-0.1 (0)
MCHC	g/dL	31-37	33.9	33.8	-0.1 (0)
RDW	%	11.5-17	13.7	13.4	-0.3 (-2)
Platelet Count	103/uL	150-450	208	332	124 (60)
MPV	fL	6.8-10.4	9.2	8.4	-0.8 (-9)
Differential Count					
Neutrophils	103/uL	1.8-7.7	3.55	4.93	1.38 (39)
Lymphocytes	103/uL	1-4.8	1.41	1.49	0.08 (6)
Monocytes	103/uL	0.2-1	0.511	0.518	0.007 (1)
Eosinophils	103/uL	0.02-0.5	0.062	0.186	0.124 (200)
Basophils	103/uL	0-1	0.028	0.053	0.025 (89)
Neutrophils	%		63.82	68.72	4.9 (8)
Lymphocytes	%		25.38	20.72	-4.66 (-18)
Monocytes	%		9.19	7.23	-1.96 (-21)
Eosinophils	%		1.11	2.59	1.48 (133)
Basophils	%		0.5	0.74	0.24 (48)
25-Hydroxy Vitamin D	ng/mL	>29; <100	57	47.3	-9.7 (-17)
Free Testosterone	pg/ml	4.81-22.42	8.97	4.55	-4.42 (-49)
Testosterone Total	nmol/L	8.33-30.20	19	12.75	-6.25 (-33)
Transferrin	mg/dl	174-364	263	225	-38 (-14)

HCT haematocrit, MCH mean corpuscular haemoglobin, MCHC mean corpuscular haemoglobin concentration, MCV mean corpuscular volume, MPV mean platelet volume, PCV packed cell volume, RDW red cell distribution width.

A previous study examined the body composition changes of 10 non-professional male runners (mean ± SD, 43.8 ± 6.2 years, 73.8 ± 6.0 kg body mass, 1.77 ± 0.05 m body height, BMI 23.3 ± 1.8 $kg \cdot m^{-2}$) competing in the 'Deutschlandlauf' 2007 a 1,200 km run within 17 consecutive days (Knechtle et al., 2008). The study reported a cumulative increase in percent total body water (6.1%; $p < 0.05$), a decrease in skeletal muscle mass (2.0 kg; $p < 0.05$) and a decrease in fat mass estimated using bioelectrical impedance analysis (3.9 kg; $p < 0.05$) (Knechtle et al., 2008). The study authors hypothesise that continuous eccentric exercise led to skeletal muscle damage, a continuous rhabdomyolysis, and impaired renal function, consequently leading to a continuous accumulation of body water (Knechtle et al., 2008). However, there are some differences between our record-breaking attempt and the ultra-endurance runners in the 1200 km Deutschlandlauf' 2007 race that might account for the differences in study findings. Our athlete was predominantly walking and racing against time to complete ~619 km over 15 shifts (mean ~8 h covering ~41 km per shift at an average moving pace of 10.11 min/km≈5.9 km/h; 29°C) whereas the ultra-endurance runners were competing in a race of 41 participants over 17 days (mean daily distance 70.9 km; mean speed 7.7 km/h; 14°C).

A recent study assessed the anthropometric changes (post- race and post-48-h race) of nine non-professional triathletes competing in an ultra-endurance triathlon (i.e. 3.8-km swimming, 180-km cycling with a positive elevation of +2600 m , 42.2-km running) in Salou, north-western Spain (race conditions: mean (range) ambient temperature was 26 °C (13 - 30 °C), the water temperature was 21 °C (20.8 - 21.2 °C) and the relative humidity was 77% (64% - 94%) (Castizo-Olier et al., 2018). The study reported a mean reduction in body mass of 5.0 kg across the nine ultra-endurance triathletes that was reversed to a -1.0 kg body mass reduction 48-h post-race (Castizo-Olier et al., 2018). Our participant's body mass remained at pre-event body mass four days after the event which means that he either maintained body mass throughout the seven days or indicates that non-professional athletes can rehydrate and refuel appropriately following ultra-endurance events. The nine ultra-endurance triathletes did not experience any change in the circumferences of the left and right thigh or calves following completion of the ultra-endurance triathlon (mean completion time 752 ± 70 min). On the contrary, bioelectrical impedance analysis data from our study suggested that the participant in the seven-day ultra-endurance walking challenge experienced a reduction in fat-mass (-7.5 kg) and a relative increase in FFM of 6.9 kg (of which 2.7 kg was estimated to be in skeletal muscle mass) with the relative gain in skeletal muscle mass predominantly occurring in the right (2.2 kg) and left leg (2.3 kg). An earlier study of eight male ultra-endurance athletes competing in the World Challenge Deca Iron Triathlon 2006 (Mexico) that entailed completing one Ironman triathlon (i.e. 3.8 km swimming, 180 km cycling, and 42 km running) every day for 10 consecutive days experienced a reduction in body fat (-3 kg) but no change in skeletal muscle mass, mineral mass, or body water (Knechtle et al., 2008). Another study assessed body composition changes in 21 well-trained male ultra-endurance runners (mean ± SD, 41.5 ± 6.9 years, 72.6 ± 6.4 kg, 178 ± 5 cm, BMI 23.0 ± 2.0 $kg \cdot m^{-2}$) who completed the Isarrun 2006 race in Germany which requires athletes to complete 338 km within 5 days (Knechtle and Kohle, 2007). Body mass and calculated fat mass did not change significantly but calculated skeletal muscle mass decreased significantly (-0.63 ± 0.79 kg) by the end of the race (Knechtle and Kohle, 2007). It is challenging to directly compare changes in body composition between different studies and ultra-endurance events due to phenotypic and training status differences between athletes, event characteristics (including mode of activity, distance/duration, climate, and terrain and topography), and methods used to estimate body composition.

The athlete in our study experienced several changes in different components of complete blood count from pre- to post-record attempt including reductions in red blood cell count, haemoglobin, and haematocrit (Table 5). However, these observations should be interpreted with caution as changes in levels of plasma constituents might be due to exercise-induced plasma volume changes where fluid shifts into (haemodilution) the intravascular space (Kargotich et al., 1998). Indeed, a study evaluating the renal and haematological effects of 16 elite ultra-endurance cyclists racing 525 km (cumulative altitude difference: 12,600 m) across the Alps reported that haematocrit and haemoglobin declined with a corresponding rise in plasma volume due to post-exercise haemodilution (Neumayr et al., 2005).

As expected during ultra-endurance events, the athlete experienced changes in biomarkers that indicate stress, cell damage, and inflammation. C-reactive protein (CRP), an acute phase reactant, is produced by the liver in response to inflammation and increased levels above basal ranges indicate muscle damage through cell injury and disruption. The athlete experienced a 30-fold increase in CRP from pre-event to four-days post-event and this value would most likely have been higher if the blood sample was taken immediately after the event. Similarly, there was an 81% increase in creatine kinase-MB (CK-MB) and 102% increase in ferritin, also an acute phase reactant, from pre- to post-event. CK-MB and ferritin are markers of cell damage (Kell and Pretorius, 2014) and the large increases experienced by the participant indicates a high degree of skeletal muscle damage as a result of the prolonged ultra-endurance walking event over seven days. A recent study of 32 male ultra-distance runners completing a 200-km race in South Korea collected blood samples <2 hours before the race, during the race at 100 km and 150 km, and at the end of 200 km, as well as after a 24 h period of recovery (Son et al., 2015). The study reported similar increases in CRP and CK-MB with values rising substantially at 150 km and 200 km and then CK-MB dropped to pre-race levels within 24 hours post-race; however, CRP remained elevated during the first day of recovery (Son et al., 2015). Moreover, another study of 21 male marathoners and ultra-marathoners participating in 42.195 km and 200 km races, respectively, reported that CK had increased 3-fold by the end of the marathon and increased 35-fold at the end of the 200-km race and remained increased until day 5 after the 200-km race (Kim et al., 2009). Similarly, CRP increased 3.4-fold one day after but not during the marathon and increased 40-fold by the end of the 200 km race and remained elevated on day six of recovery (Kim et al., 2009). Interestingly, there was a 1.6-fold increase in cartilage oligomeric matrix protein (COMP), a marker of cartilage breakdown (Andersson et al., 2006), at 10 km during the marathon race that declined to the pre-race level after 2 days recovery and 1.9-fold increase after a 200-km race that was maintained until day 3 of recovery, only returning to the pre-race level on day 6 (Kim et al., 2009). We did not measure COMP in this study; however, future research may want to consider including COMP as a biomarker to explore the effect of ultra-endurance walking and running on cellular changes in cartilage (Andersson et al., 2006).

A multi-day walking/running ultra-endurance record attempt is physiologically demanding and the athlete in our study experienced reductions in several hormones including thyroid stimulating hormone (-43%), free testosterone (-49%), and total testosterone (-33%). Ultra-endurance events are known to increase levels of cortisol and decrease testosterone (Knechtle and Nikolaidis, 2018). We were unable to measure cortisol in the present study; however, this hormone inhibits the secretion of thyroid-stimulating hormone from the pituitary gland and the decrease in thyroid-stimulating hormone observed in our study might be due to increased cortisol levels. Nonetheless, our findings are aligned with a recent case study of an athlete on a record-breaking 36-h nonstop underwater endurance performance that reported a reduction in thyroid-stimulating hormone one day after the event (Verratti et al., 2021). In addition, another study assessed the hormonal changes of 11 endurance trained runners during a 110 km ultra-marathon and reported that compared to a control group, there were significant increases in cortisol and decreases in testosterone during the race (Fournier et al., 1997).

Practical applications

Pre-Event Nutritional Assessment. The participant had borderline anaemia prior to the event and his haemoglobin levels decreased to 12.2 g/dL indicating mild anaemia according to the World Health Organisation cut-offs (i.e. <13.0 g/dL) (WHO, 2011). Similarly, the participant experienced reductions in red blood cell count (-8%) and serum iron (-74%) as a result of the body's increased requirement for iron during prolonged bouts of strenuous physical activity. A recent study of 10 athletes completing a 54 km and six athletes in a 111 km ultra-endurance mountain running race reported reductions in erythrocytes, haematocrit and haemoglobin concentration after 54 km and 111 km races at 24, 48 and 72 h (Rubio-Arias et al., 2019). In view of iron's importance in energy metabolism, oxygen transport, and acid-base balance, it is advisable for all ultra-endurance athletes to have a full blood profile and nutritional assessment three and six months before events and races to ensure the parameters are within the normal ranges. Indeed, the participant's performance in our study might well have been improved if he had haemodynamic parameters within the normal ranges before and during the early stages of the seven-day walking challenge. Therefore, we suggest that both professional and amateur athletes consult a sports medicine physician in the pre-planning stage of training for an ultra-endurance event to ensure that any nutritional deficiencies are detected sufficiently early to allow for appropriate intervention.

Walking Technique. The participant reported completing a relatively high volume of running (15 h/wk) six months prior to the challenge that resulted in a hip flexor injury that prevented training for one month. Whilst musculoskeletal injuries are common during intense training periods for ultra-endurance events, the risk of injury might have been reduced if our participant had incorporated specific strength work, walking flexibility, mobility, and technique work into his training programme. For example, a male ultra-endurance walker who used the Nordic walking technique (using walking poles) to break the "Longest Marathon Nordic Walking" Guinness World Record covering 274 km in 70 hours incorporated both indoor and outdoor training into his preparation programme (Pedrinolla et al., 2017). Specifically, outdoor training sessions focused on improving walking technique and efficiency, and the primary aim of indoor sessions was to strengthen musculoskeletal structures predominantly involved in ultra-endurance walking events (Pedrinolla et al., 2017). Our participant might have benefitted from including technique, flexibility, and mobility training into his pre-event training programme and this might have reduced some of the musculoskeletal pain he experienced during the event.

Mental Skills. In addition to physical preparation, an important aspect of any training programme for a single or multi-day ultra-endurance event is psychological skills development, especially to cope with physical pain, discomfort, sleep deprivation, and injury. A recent study assessing the mental toughness, sleep, mood and injury rates of 12 participants (3 females, 9 males; mean age 42.0 ± 5.4 yrs) competing in a 120-mile, three-day Arctic ultra-marathon found that mental toughness (measured using the MT18 questionnaire) had a moderate negative correlation ($p < 0.01$) with depression (-0.623), reduced anger (-0.616), confusion (-0.558), increased vigour (0.497), and tension (-0.420) during the race (Graham et al., 2021). Optimal performance and success in single or multi-day ultra-endurance events requires significant psychological and physiological preparation to minimize the effects of sleep deprivation, physical discomfort, and both physical and mental fatigue on performance. A similar study assessing mood states (Brunel Mood Scale) and injury rates amongst 11 male participants competing in the 7-day, 250 km Gobi Desert Ultramarathon in Mongolia reported that levels of depression, tension, and confusion increased throughout the multiday event, peaking at days 5/6, and both anger ($r = 0.736$) and fatigue ($r = 0.768$) correlated strongly with sleep disruption (Graham et al., 2012). Whilst we did not collect quantitative assessments of psychological states or wellbeing, it is clear from the qualitative verbatim quotes in the results (Table 2) that the participant experienced a range of emotional and psychological states during the seven days. Our participant did not incorporate any psychological skills or resilience components to his pre-challenge training program and this might have benefitted his performance during the extremely physically and/or psychologically demanding stages of the challenge.

Limitations

The research team were not able to conduct anthropometric and blood sampling measurements until four-days post-event. As such, the data collected provides biological values for the participant during the initial recovery stage of completing the event. Nonetheless, there were clinically important changes in various biomarkers four-days post-record attempt compared to pre-event baseline values.

Conclusion

This case study presents novel data on the physiological demands of successfully traversing the 620 km of the UAE in 7-days by foot. Amateur athletes attempting similar ultra-endurance races or challenges may want to consider developing a training programme that includes a pre-event health assessment, nutritional plan for pre-, during, and post-event, and sport-specific strength and conditioning, and mental health skills development to maximise performance and minimise the risk of injury.

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Key points

- This study assessed the personal experience and physiological responses of a non-professional athlete attempting the Guinness World Record of covering 620 km on foot across the United Arab Emirates in 7-days or less.
- Despite a well-defined nutritional and walking pace plan, the participant suffered from gastrointestinal pain and diarrhea during day 1 and physical pain from day 2 due to failure of adhering to the nutrition and pacing strategy.
- The athlete experienced changes in biomarkers that indicate stress, cell damage, and inflammation including a 30-fold increase in c-reactive protein, an 81% increase in creatine kinase-MB (CK-MB) and 102% increase in ferritin from pre- to post-event.
- The participant was borderline anaemic prior to the event and his haemoglobin levels decreased by 9% by the end of the challenge to 12.2 g/dL classifying him with mild anaemia; however, this may be due to post-exercise haemodilution.
- This case study observations reinforce the importance of (i) consulting a sports medicine physician in the pre-planning stage; (ii) adhering to a pre-planned hydration and nutrition strategy and training the gastrointestinal tract to tolerate high glucose intakes during prolonged physical exertion; (iii) complementing endurance training with sport-specific strength and conditioning; and (iv) psychological skills development, especially to cope with physical pain, discomfort, sleep deprivation, and injury.

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