FIVB Heat Stress Monitoring Protocol – FIVB Beach Volleyball World Tour

Background

Based on our practical experience with FIVB World Tour, there seemed to be a discrepancy between the heat stress guidelines available internationally and the actual risk of heat-related illness among the professional players competing on the beach volleyball World Tour. Therefore, the FIVB decided in 2009 to establish a surveillance program to monitor heat stress and record any cases of heat-related medical forfeits on the Swatch FIVB World Tour. The detailed data from the initial 3 years of surveillance were published in the British Journal of Sports Medicine (Bahr & Reeser, 2012).

The report confirms that the risk of significant heat illness in professional beach volleyball on the World Tour is very low, even though hot and humid conditions exceeding US Navy Black flag conditions (WBGT>32.3°C) are encountered frequently. In fact, during three seasons there were no match forfeits because of heat stress on the tour. The BJSM therefore report concluded that currently available heat stress guidelines are too conservative to assess the sport-specific risk of heat illness in beach volleyball, and thus to help inform reasonable safety decisions, and that monitoring should continue.

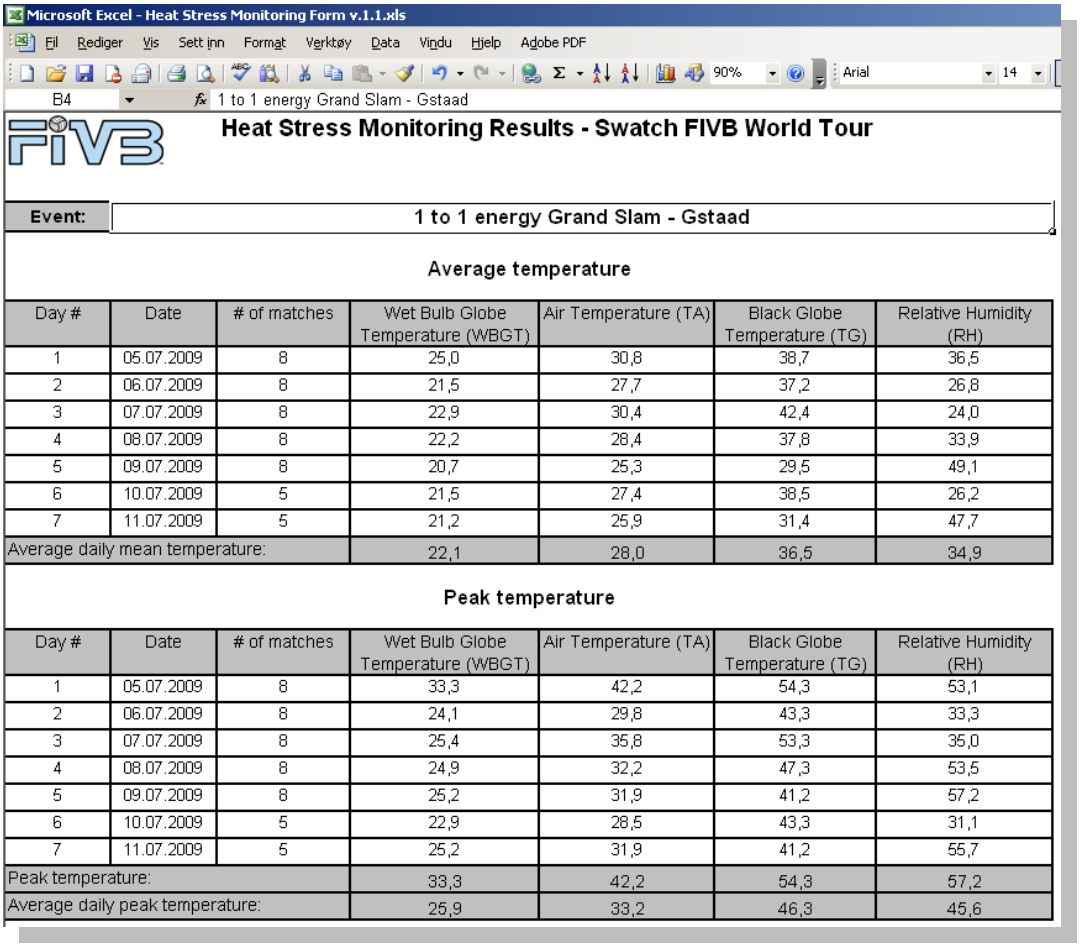
Procedures

The FIVB Heat Stress Monitoring Protocol was started in June 2009 during the SWATCH FIVB World Championships in Stavanger and consists of three elements; 1) WBGT measurements on center court during all events on the FIVB World Tour, 2) Continuous data collection covering all events, and 3) systematic recording of any heat-related medical forfeits on the Tour. The data collection and reporting is the responsibility of the FIVB Referee Delegate (and FIVB Medical Delegate, if present).

WBGT Measurements

Temperature measurements are taken on center court 5 min before the start of each game in front of the scorer's table, apx. 1.5 m above the sand level. If the scorer's table is shaded, the measurement must be made closer to the court or even on court in the sunny area. No measurements are necessary from the outside courts. The measurements are to be taken by a reserve referee (or the referee of the match before). The following data are recorded on the Heat Stress Monitoring Form: Wet Bulb Globe Temperature (WBGT), Air Temperature (TA), Black Globe Temperature (TG) and Relative Humidity (RH) using a Heat Stress WBGT Meter (Model HT30, Extech Technology).

The data are entered in a custom-made spreadsheet as shown in the example below:



Microsoft Excel - Heat Stress Monitoring Form v.1.1.xls

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B4 1 to 1 energy Grand Slam - Gstaad

Heat Stress Monitoring Results - Swatch FIVB World Tour

Event:	1 to 1 energy Grand Slam - Gstaad

Average temperature

Day #	Date	# of matches	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
1	05.07.2009	8	25,0	30,8	38,7	36,5
2	06.07.2009	8	21,5	27,7	37,2	26,8
3	07.07.2009	8	22,9	30,4	42,4	24,0
4	08.07.2009	8	22,2	28,4	37,8	33,9
5	09.07.2009	8	20,7	25,3	29,5	49,1
6	10.07.2009	5	21,5	27,4	38,5	26,2
7	11.07.2009	5	21,2	25,9	31,4	47,7
Average daily mean temperature:			22,1	28,0	36,5	34,9

Peak temperature

Day #	Date	# of matches	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
1	05.07.2009	8	33,3	42,2	54,3	53,1
2	06.07.2009	8	24,1	29,8	43,3	33,3
3	07.07.2009	8	25,4	35,8	53,3	35,0
4	08.07.2009	8	24,9	32,2	47,3	53,5
5	09.07.2009	8	25,2	31,9	41,2	57,2
6	10.07.2009	5	22,9	28,5	43,3	31,1
7	11.07.2009	5	25,2	31,9	41,2	55,7
Peak temperature:			33,3	42,2	54,3	57,2
Average daily peak temperature:			25,9	33,2	46,3	45,6

Recording of heat-related medical forfeits

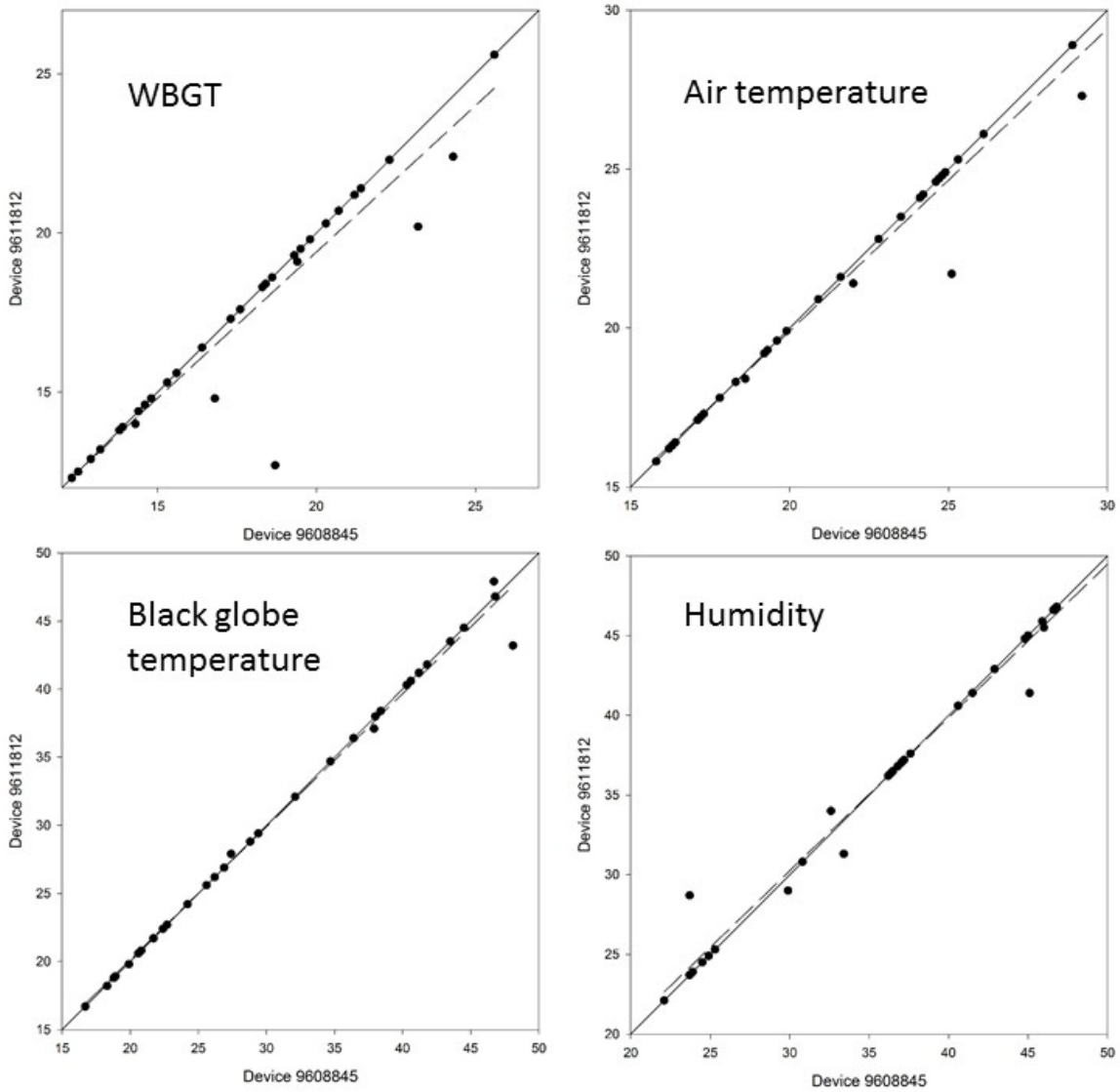
In any case of any medical forfeit, the injured player is asked by the referee if this is due to heat exhaustion and/or dehydration. If this is the case, the player is also asked, if he/she has suffered from diarrhea during the past five days? This information is reported to the Referee Delegate, who is responsible for including it in the report.

Results from the 2014 season

Reproducibility

Occasionally, reports include temperature data where there is one reading substantially deviating from the previous and next reading. Since readings are normally taken at the start of each match, i.e. approximately every hour, this indicates that the report may be inaccurate. To test the reproducibility of the method, we therefore collected data based on independent recording from two devices during the Stavanger Grand Slam event. As shown in the figure below, reproducibility is generally excellent. However, there are a few recordings with a conspicuous discrepancy between the two, especially for the key

variable, WBGT. The reasons for these errors are not known, but are most likely related to operator error or incorrect data entry.



Based on this, a memo was sent to the Referee Delegates to carefully examine the numbers, comparing with the previous reading to check if the readings are consistent. If there is a dramatic change in readings, they have been asked to do the measurement a few extra times. They have also been reminded of the technical points: that the protective sliding cover must be open, to allow air (wind) to stream through the meter and that the meter should always be set for outside mode, regardless if there is direct sun exposure or not.

Events included

Complete data sets have been received from the FIVB U19, U21 and U23 World Championships, the Youth Olympic Games, and 15 of 20 Grand Slam and Open events.

This means that data are available from a total of 19 events from 2014, as shown in the table below:

Dates	Country	Event	#	
22 - 27 April	China	Fuzhou	81	OP
29 April - 4 May	China	Shanghai	82	GS
6 May - 11 May	Mexico	Puerto Vallarta	83	OP
21 - 25 May	Czech Rep.	Prague	84	OP
10 - 15 June	Poland	Myslowice	85	U23
11 - 15 June	Russia	Moscow	86	GS
17 - 22 June	Germany	Berlin	87	GS
24 - 29 June	Norway	Stavanger	88	GS
8 - 13 July	Switzerland	Gstaad	89	GS
15 - 20 July	Netherlands	The Hague	90	GS
16 - 20 July	Mexico	Acapulco	91	U17
22 - 27 July	USA	Long Beach	92	GS
23 - 27 July	Cyprus	Larnaca	93	U21
29 July - 3 August	Portugal	Porto	94	U19
29 July - 3 August	Austria	Klagenfurt	95	GS
17 - 27 August	China	Nanjing	96	YOG
19 - 24 August	Poland	Stare Jablonki	97	GS
7 - 12 October	China	Xiamen	98	OP
28 October - 2 November	Argentina	Parana	99	OP
4 - 8 November	Qatar	Doha	100	OP
9 - 14 December	South Africa	Mangaung	101	OP

OP: Open, GS: Grand Slam, U23: U23 World Championships, U21: U21 World Championships, U19: U19 World Championships, U17: U17 World Championships, YOG: Youth Olympic Games

Temperature data

The results are shown in the table below as Wet Bulb Globe Temperature (WBGT), Air Temperature (TA), Black Globe Temperature (BG) and Relative Humidity (RH). The table shows the average values for the entire event, the peak value during the event, as well as the average daily peak value for each of these variables.

	Average				Peak				Average daily peak			
#	WBGT	TA	BG	RH	WBGT	TA	BG	RH	WBGT	TA	BG	RH
81	20.6	22.4	24.4	76.2	29.7	34.7	48.1	99.8	22.1	24.3	28.2	84.9
82	19.3	22.4	26.6	58.8	25.1	29.9	42.5	82.2	21.7	24.7	32.2	71.1
83	16.4	19.1	24.3	58.2	24.0	28.7	58.2	99.9	21.0	24.8	40.0	77.7
84	23.4	28.8	39.2	41.7	28.8	38.6	62.9	86.3	26.8	34.3	49.8	59.2
85	21.3	26.1	34.5	44.6	32.3	46.7	71.8	86.5	24.8	32.9	44.7	61.9

	Average				Peak				Average daily peak			
#	WBGT	TA	BG	RH	WBGT	TA	BG	RH	WBGT	TA	BG	RH
86	27.7	29.9	38.3	68.4	30.3	33.8	46.8	91.5	29.5	32.2	43.8	78.1
87	17.3	21.1	27.3	46.7	25.0	30.8	52.4	75.5	20.5	25.1	38.6	60.5
88	17.8	21.7	32.4	37.3	25.6	30.3	47.9	53.0	22.9	27.1	45.7	48.0
89	13,8	14,3	18,1	83,0	22,2	24,2	37,1	99,9	16,6	17,7	24,5	94,7
90	23.5	26.2	34.9	59.4	35.8	41.8	71.0	92.9	28.9	31.9	53.8	73.1
91	31,0	34,1	44,3	57,8	33,1	39,6	53,4	72,3	32,3	37,2	51,0	66,5
92	24.9	27.5	41.0	55.7	28.9	35.7	68.9	79.4	27.0	31.3	50.0	72.2
93	28.4	32.6	38.6	55.3	35.7	41.7	57.2	84.1	32.7	38.1	52.4	71.5
94	22.2	24.9	33.8	61.0	26.6	37.6	49.2	99.9	25.2	30.7	41.3	74.9
95	23.1	26.3	34.8	57.6	29.2	37.7	58.1	99.9	26.7	31.0	46.5	79.5
96	26.9	28.4	32.9	75.6	36.1	41.2	64.5	99.9	30.6	34.4	43.8	92.5
97	19.0	23.5	29.9	41.3	25.1	34.8	50.2	55.0	22.6	28.3	42.3	50.0
98	25.5	31.4	38.0	42.2	32.6	43.4	57.2	62.4	28.1	35.7	48.1	53.8
99	22.9	25.1	31.3	15.6	34.7	33.8	48.0	34.3	25.5	27.6	37.5	21.6
100	21.4	26.6	28.1	49.9	29.2	34.2	47.5	65.9	23.8	29.7	33.8	57.4
101	24.2	30.6	40.7	29.4	30.6	37.9	58.6	51.9	28.3	35.5	50.8	41.3

The US Navy Heat Stress Warning System dictates that when the WBGT ranges between 31 and 32, activity should be stopped for all but the most acclimatized individuals, while activity should be suspended for all personnel when the WBGT exceeds 32. Assuming that professional beach volleyball players are well acclimatized to exercise in hot and humid conditions, it would seem reasonable to use WBGT >32 as the stoppage criterion. The table therefore highlights events which the conditions have exceeded the US Navy guideline; this amounts to seven events in total during the 2014 season, the U23, U21 and U17 World Championships, the Youth Olympic Games in Nanjing, two Opens and one Grand Slam.

Heat-related forfeits

Three cases of heat exhaustion were reported by the referees, all during hot and humid conditions and in closely fought 1-2 matches. However, the players involved all completed the match and therefore did not meet the inclusion criteria for medical forfeits in the surveillance protocol.

Conclusions and recommendations

The 2014 data does not change the conclusions drawn based on the first 3 years of data collection. We now have 6 years of data, including 101 events, that it appears to be safe for professional beach volleyball players, including under-age categories, who are well acclimatized to exercise under hot and humid conditions, to compete under conditions well above a WBGT of 32.

Nevertheless, it is recommended that:

1. FIVB Heat Stress Monitoring Protocol is continued as a standard procedure on the FIVB Beach Volleyball World Tour and World Championships, in order to safeguard the health of or athletes and to build a larger database on which to base future recommendations.

2. To increase the compliance with and ease of the protocol, that one WBGT device is supplied by the FIVB to each of the FIVB Referee Delegates prior to the start of the season.