Characteristics of a Polar Bear Swim Champion –
The Challenges of San Francisco Bay Winter Swimming

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ABSTRACT
In this report we discuss the characteristics of a 56-year-old man who, as part of a
record-matching Polar Bear Challenge swimming event, swam a remarkable 356
cumulative miles without a wetsuit in the San Francisco Bay over a 3-month period in
winter (December 21, 2012 to March 21, 2013; water temperature range: 9.5 °C (49.1
°F) to 12.9 °C (55.2 °F)). The swimmer had a recreational swimming background and
was not overweight or obese. At time points before, during, and after (November to August) the winter swim period, his body mass index (BMI) ranged from 22.7 to 23.2
kg/m² (normal BMI: 18.5 to 25.0 kg/m²). His % body fat (measured range: 17.6 to 20.7%) was consistently below the American 50th percentile for age (23.2%). 4 days
after the winter swim period his resting pulse was 54 bpm. Serum total cholesterol
was near normal (borderline high) and was not substantially different before (200
mg/dl) compared to after (212 mg/dl) swimming consistently in cold water for 3
months. During the winter swim period the swimmer contracted severe shingles,
which added to an already challenging experience. Because he was relatively lean, he
likely did not have substantial protection from core hypothermia. Rather, the
swimmer’s ability to swim in cold water was related to a combination of experience,
acclimatization, access to warm showers and saunas, mental fortitude, and most
importantly, a swim strategy that limited time in the water per swim.

INTRODUCTION
Swimming in cold open water continues to increase in popularity and attracts
swimmers with a wide variety of athletic backgrounds (2,3,11,17,18). Each winter,
members of the Dolphin Club (San Francisco, CA) participate in the annual Polar
Bear Challenge, which requires swimmers to swim consistently throughout the
winter months in the San Francisco Bay without wetsuits.

The Polar Bear Challenge is unique in that it allows participation on a variety of
athletic levels, with a focus on accumulation of swimming distance over several
months, rather than speed or single-swim endurance. In this report, we outline the
detailed physical and other characteristics of a champion Polar Bear swimmer. In
the winter of 2012/2013, the swimmer, a 56-year-old man, swam a remarkable 356
cumulative miles over a 3-month winter period, all in the San Francisco Bay, and all
without a wetsuit or other swim aids. The swimmer provided written consent to the authors for the use of information mentioned in this report.

As we will outline, the swim was marked by substantial challenges, requiring dedication in the face of persistently low water temperatures, open water conditions, and illness. Clearly, the swimmer faced and overcame both physical and psychological barriers. In this report we provide details of the event, physical characteristics of the swimmer, including changes over time, and the athlete’s own insights into cold-water swimming.

CASE STUDY

General Event Description and Background

The Polar Bear Challenge

For over 30 years, the Dolphin Club has organized its annual Polar Bear Challenge. The event officially begins on the first day of winter (December 21) and ends on the first day of spring (March 21). Founded in 1877, the Dolphin Club currently has over 1500 members, and the Polar Bear Challenge is open to any member in good standing.

During the 3-month winter interval, swimmers endeavor to swim a minimum total of 40 cumulative miles in the San Francisco Bay without wetsuits or swim aids. While 40 miles is the minimum distance required to achieve Polar Bear status, participants can exceed this distance, with honors going to the swimmer who accumulates the greatest number of miles.

Swimmers are permitted to swim at an individual pace. Following each swim, they self-record miles on a common recording chart. Although the honor system is employed, the recording chart is publically posted in a common area of the Dolphin Club. Recorded miles are thus subject to the view and scrutiny of the club’s swim commissioners and other club members.

Swimmers may swim as many times a day as they like. The Dolphin Club facilities are located on the shore of the San Francisco Bay, and warm showers and saunas are available to all swimmers both before and after swimming. Although wetsuits are prohibited, insulating neoprene caps are permitted and common. With the exception of sanctioned swims, swimmers must stay inside Aquatic Park, a designated San Francisco Bay swim area located near the historic Hyde Street Pier and Fisherman’s Wharf.

Prior Polar Bear Swims and Records

In the winter of 2003/2004, a 48-year-old man, employed as a flight instructor, shattered the prior Polar Bear record of 256 miles (set in 2002/2003), by swimming 356 cumulative miles in the 3-month winter period. This record required
swimming an average of 4 miles per day in cold open water. In the winter of
2006/2007, a 47-year-old man, employed as a baker, tied the record of 356 miles.
In a remarkable show of sportsmanship, the 47-year-old baker declined to break the
2003/2004 record; after reaching 356 miles, with time left in the competition
interval, he swam no farther. Although the record was not broken, the baker did
receive the Polar Bear award for the most miles that year and the admiration of all
in the Dolphin Club. By convention, 356 miles became the Dolphin Club’s Polar Bear
mark to beat – or with a nod to sportsmanship – to match.

2012/2013 Polar Bear Challenge and Record-Matching Attempt

Shortly prior to the start of the 2012/2013 Polar Bear Challenge, the swimmer in
this report, a 56-year-old man, employed as a website designer, announced that he
would attempt a record-matching swim. Honoring the gesture established by a
prior swimmer in 2006/2007, the goal of our report’s swimmer was to match, but
not exceed, 356 cumulative miles during the 3-month winter period.

Swimmer Characteristics and Description of 2012/2013 Event

Swimmer’s Athletic and Employment Background

At the time of the 2012/2013 Polar Bear Challenge, the swimmer was 56 years old.
Between December 21, 2012 and January 7, 2013 he was unemployed, but he
started a new job as a website designer on January 7, 2013 and was employed full-
time for the remainder of the event.

The swimmer had a predominantly recreational swimming background. He joined
the Dolphin Club in 2006. Prior to joining he had minimal open-water swimming
experience. He did not swim competitively in either high school or college.

Between 2006 and 2012 he participated in numerous Dolphin Club open-water
swims (distance range typically 1-2.5 miles – all without wetsuits). In 2010 he
participated in a successful English Channel relay event. In 2011 he prepared for a
solo English Channel crossing but was unable to attempt the swim because of
adverse weather conditions (swim aborted prior to start). Before swimming in the
2012/2013 Polar Bear Challenge, he had completed 4 previous Polar Bear
Challenges.

Unable to enter the water for a solo English Channel attempt in 2011, the swimmer’s
goal was a solo English Channel crossing in the summer of 2013. He intended to use
the 2012/2013 Polar Bear Challenge as the initial training for his anticipated solo
English Channel crossing attempt later in 2013.

Swimmer’s Typical Swim Pattern and Event Course

The swimmer began swimming on December 21, 2012. In the initial weeks of the
swim, he swam 3-6 times per day throughout the day, with a distance varying
between 0.5-1.5 miles per swim, and a range of 3-8 miles per day.
On January 7, 2013, the swimmer began a new job that required him to work between 9AM and 5PM. He adjusted his swim schedule accordingly and swam both before and after work. Typically, he would rise from bed at 4:00 AM and enter the water by 5:15 AM. Prior to work, he would usually complete 2 or 3 swims that varied in distance from 0.5-1.0 miles. After work, between 5:30PM and 9PM, he would return to the Aquatic Park cove to complete several swims also of varying distance. Given the winter season, the majority of these swims were done in the dark. On a typical workday, the swimmer would swim a total of approximately 4 miles. On weekends, he increased his swim distance to between 5 and 8 miles per day with swims of 0.5-2.5 mile increments.

In compliance with the event rules, the swimmer did not wear a wetsuit or use swim aids. With the exception of sanctioned swims, he remained inside the cove of Aquatic Park, the designated swim area for the Dolphin Club. He did wear an insulating neoprene cap, which was permitted both by club convention and the event rules. The swimmer utilized the sauna frequently before and after swims. Additionally, he frequently planned his swims to coincide with tide patterns such that tidal currents were more likely to assist his progress; however he began and ended all swims at the same point on the Dolphin Club beach in Aquatic Park.

The swimmer continued his grueling swim pattern throughout the winter months, averaging 4 miles of open-water swimming per day. In the final two weeks of the swim period, he contracted severe shingles (Figure 1) that required him to stop swimming for two days. Shingles is a viral illness characterized by a painful skin rash typically on one side of the body. The virus responsible for the shingles is the varicella-zoster virus, the same virus that causes chickenpox; after an initial illness with chickenpox the varicella-zoster virus can remain dormant in the body for years, only to surface again as shingles at a later date (21). Shingles is most severe in the first few days and typically lasts between 2 and 4 weeks.

Figure 1a (anterior view)
Figure 1. Severe Shingles in a Polar Bear Swimmer
(Photos taken 3.11.13 - early in the illness).

The swimmer was treated with an appropriate medication and following only 2
days of rest, he resumed swimming at an increased pace, averaging 7 to 8 miles a
day in order to remain on schedule. Additionally, a week prior to the completion
date, the swimmer lost a crown from one of his molars, causing severe tooth pain.
Unable to schedule a dentist visit without compromising his swim schedule, he
continued to swim with the tooth exposed.

On March 21, 2013, with a crowd of admiring club members and the local media in
attendance, the swimmer completed mile 356, thereby tying the record distance
established in prior years. As another had done previously, the swimmer
intentionally declined to break the record. With ample time remaining in the day, he
exited the water after mile 356 and did not swim farther.

**Water Temperature and Weather Conditions**

The San Francisco Bay water temperature during the winter swim period
(December 21, 2012 – March 21, 2013) ranged from 9.5 °C (49.1 °F) (January) to
12.9 °C (55.2 °F) (December); air temperature in San Francisco in the proximity of
the Dolphin Club ranged from 3.7 °C (38.7 °F) (January; night) to 19.5 °C (67.1 °F )
(March; daytime) (16).

Further breakdown of water temperature in both Celsius and Fahrenheit by 8-11
day intervals is show in Table 1.
TABLE 1. Interval High and Low Winter Water Temperatures of the San Francisco Bay (December 21, 2012 – March 21, 2013)

<table>
<thead>
<tr>
<th>Dates</th>
<th>Low Temp °C (°F)</th>
<th>High Temp °C (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC 21 -31</td>
<td>10.7 (51.3)</td>
<td>12.9 (55.2)</td>
</tr>
<tr>
<td>JAN 1-10</td>
<td>9.9 (49.8)</td>
<td>11.8 (53.2)</td>
</tr>
<tr>
<td>JAN 11-21</td>
<td>9.5 (49.1)</td>
<td>11.4 (52.5)</td>
</tr>
<tr>
<td>JAN 21 -31</td>
<td>9.5 (49.1)</td>
<td>10.9 (51.6)</td>
</tr>
<tr>
<td>FEB 1-10</td>
<td>10.1 (50.2)</td>
<td>11.3 (52.3)</td>
</tr>
<tr>
<td>FEB 11-20</td>
<td>10.2 (50.4)</td>
<td>11.3 (52.3)</td>
</tr>
<tr>
<td>FEB 21-28</td>
<td>10.1 (50.2)</td>
<td>11.1 (52.0)</td>
</tr>
<tr>
<td>MAR 1-10</td>
<td>10.4 (50.7)</td>
<td>11.4 (52.5)</td>
</tr>
<tr>
<td>MAR 11-21</td>
<td>10.8 (51.4)</td>
<td>12.5 (54.5)</td>
</tr>
</tbody>
</table>

Data obtained from National Oceanic and Atmospheric Administration's (NOAA's) National Data Buoy Center (15). Temperature data buoy at Crissy Field (Station FTPC1), located approximately 1 mile from the Aquatic Park swim area.

Both air and water temperatures in San Francisco during the 2012/2013 winter were grossly consistent with prior seven-year averages (2006-2012) (16). Drought conditions were prevalent in San Francisco in 2013; during the 2012/2013 Polar Bear swim interval, it rained a total of 23 days with a total of 6.59 inches of rain recorded (8). Weather or water conditions did not prevent the swimmer from swimming. As outlined above, he swam every day with the exception of two days in March, after contracting shingles.

Biophysical Parameters

The swimmer consented to the measurement and reporting of 3 categories of biophysical parameters: 1. body composition (including weight, body mass index (BMI), and % fat), 2. resting heart rate and blood pressure, and 3. lipid profile. Body temperature was not measured in this study. Data were obtained from a variety of sources, including from an employment physical examination, from a prior scientific study of cold-water swimmers (in which the swimmer had participated) (17), self-measurements by the swimmer, and detailed measurements by the authors during and after the Polar Bear Challenge interval.
Body Composition

Body composition measurements were made at 6 time points. The swimmer did not intentionally attempt to lose or gain weight during this period. In March 2011, the swimmer participated in a prior study of Polar Bear swimmers (17); that study measured height and weight, and neck and abdominal circumference in a large group of recreational open-water swimmers. The swimmer’s weight was recorded at an employment physical in November 2013. In January, March, July, and August of 2013, the swimmer consented to repeat measurements (by the authors of this report) of weight and neck and abdomen circumference. In addition, skinfold measurements using standardized calipers were also made by the authors at the later dates. BMI was calculated by dividing the swimmer’s weight in kilograms by the square of his height in meters (kg/m$^2$) (1,22). % fat was estimated in two ways: 1. using the Navy circumference method (from neck and abdomen circumferences) (10,17,18,22), and 2. using skinfold thickness from 3 sites (chest, abdomen, and thigh) (1). Additional details regarding these techniques can be found in Department of Defense instructions (22), American College of Sport’s Medicine’s Guidelines (1), and other publications (10,17,18). Results are summarized in Table 2.

**TABLE 2.** Body Composition of a Polar Bear Swimmer at 6 Time Points

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight kg (lbs)</th>
<th>BMI (kg/m$^2$)</th>
<th>% Fat (Navy Method)</th>
<th>% Fat (3-site Skinfold Method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE EVENT: March 19, 2011*</td>
<td>71.4 (157.5)</td>
<td>22.8</td>
<td>18.2</td>
<td>Not recorded</td>
</tr>
<tr>
<td>BEFORE EVENT: November 9, 2013†</td>
<td>73.9 (163.0)</td>
<td>23.6</td>
<td>Not recorded</td>
<td>Not recorded</td>
</tr>
<tr>
<td>DURING EVENT: January 5, 2013</td>
<td>73.0 (161.0)</td>
<td>23.3</td>
<td>18.6</td>
<td>20.7</td>
</tr>
<tr>
<td>AFTER EVENT: March 25, 2013</td>
<td>72.0 (158.75)</td>
<td>23.0</td>
<td>17.7</td>
<td>18.0</td>
</tr>
<tr>
<td>AFTER EVENT: July 19, 2013</td>
<td>72.5 (159.75)</td>
<td>23.2</td>
<td>18.2</td>
<td>18.7</td>
</tr>
<tr>
<td>AFTER EVENT: August 22, 2013</td>
<td>71.0 (156.5)</td>
<td>22.7</td>
<td>17.7</td>
<td>17.6</td>
</tr>
</tbody>
</table>

The Polar Bear Challenge event interval was December 21, 2012 to March 21, 2013.

*Data obtained from prior study of cold-water swimmers in which the swimmer had participated (17); height was measured in that study using a Secca stadiometer.
†Data from employment physical.

All other measurements were made by the authors using a balance scale, flat tape measure, and Lange skinfold calipers. Formulae and additional details pertaining to % fat calculations can be found in DOD instructions (22), ACSM Guidelines (1), and other publications (10,17,18).

BMI is considered normal in the following range: 18.5 to 24.9 kg/m$^2$ (1).
50th percentile for % body fat for American men age 50-59 years: 23.2% (1).
From the data above, the swimmer’s BMI remained in the normal range. At all points measured, % fat was lower than the 50th percentile for age (23.2%) (1). The swimmer had a regular diet during the swim – caloric intake was not specifically tracked. The swimmer lost weight during and after the Polar Bear Challenge. However, the swimmer’s weight, BMI, and % fat changes were relatively modest. Weight varied maximally by 2.9 kg (6.5 lbs), and BMI varied maximally by 0.9 kg/m². By the Navy circumference method, % fat varied by less than 1%. By the 3-site skinfold method, % fat varied by less than 3.5% (no 3-site skinfold measurements prior to the Polar Bear Challenge).

**Resting Heart Rate and Blood Pressure**

Between November 9, 2012, and April 30, 2013, the swimmer’s resting heart rate was recorded a total of 5 times and ranged from 54 to 66 bpm. Although no clear changes in heart rate during the winter swim period were apparent, the lowest heart rate (54 bpm) was recorded on March 25, 2013 (4 days after the Polar Bear Challenge). Before the Polar Bear Challenge, at an employment physical on November 9, 2012, the swimmer’s recorded blood pressure was 124/80 mm Hg; blood pressure was similar (121/84 mm Hg) after the event on April 29, 2013, when measured by the swimmer using an automated device.

**Lipid Profile**

As part of an employment physical, the swimmer’s cholesterol was measured on November 9, 2012 (prior to start of the Polar Bear Challenge). He additionally consented to repeat cholesterol measurement on April 23, 2013 (after the completion of the Polar Bear Challenge). Results are summarized in **Table 3**.

**TABLE 3. Lipid Profile Before and After Winter Polar Bear Swim Event**

<table>
<thead>
<tr>
<th>Date</th>
<th>Total (mg/dl)</th>
<th>TG (mg/dl)</th>
<th>LDL (mg/dl)</th>
<th>HDL (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE EVENT: November 9, 2012</td>
<td>200</td>
<td>62</td>
<td>126</td>
<td>61</td>
</tr>
<tr>
<td>AFTER EVENT: April 23, 2013</td>
<td>212</td>
<td>72</td>
<td>132</td>
<td>66</td>
</tr>
</tbody>
</table>

The Polar Bear Challenge event interval was December 21, 2012 to March 21, 2013.

**Abbreviations and Reference Ranges (15):**
- **Total Cholesterol (Total):** desirable: <200 mg/dl; borderline high: 200-239 mg/dl; high: ≥240 mg/dl.
- **Triglycerides (TG):** normal: <150 mg/dl.
- **LDL Cholesterol (LDL):** optimal:<100; near optimal/above optimal:100-129; borderline high:130-159; high:160-189; very high≥190.
- **HDL Cholesterol (HDL):** low:<40; high:≥ 60 mg/dl (low HDL with increased cardiac risk; high HDL potentially beneficial).
In general, all values appear to have been within grossly accepted normal or borderline high ranges (15), and no substantial changes were apparent after the 3-month Polar Bear Challenge event when compared to before the event.

**Psychological Aspects**

In the Dolphin Log, a quarterly Dolphin Club publication (18), the swimmer described the psychological barriers involved with this endeavor. He specifically reported a feeling of “dread that grew into a demon.” The feeling would begin in the middle of the night and grow in intensity as the 4 AM wake-up alarm approached. The dread resolved with the morning swim, but returned again as the evening swims approached. The swimmer reported that by focusing on each swim itself, the small joys of swimming, and the beauty of the moment, and by utilizing visualizations of warmer environments (e.g., a warm beach in Guam), he was able to overcome these feelings of dread.

The swimmer well could have abandoned the swim when he contracted shingles a few weeks prior to the completion deadline. But with dedication and careful planning, he was able to make up lost miles and achieve his goal. The swimmer also credited his success to strong support and encouragement from an extended group of club members, family, and friends.

**Follow-up and Subsequent English Channel Attempts**

Although the Polar Bear Challenge was intended as preliminary training for an English Channel solo attempt, following the winter event the swimmer reported that he felt weaker, not stronger. Shortly after the Polar Bear event, the swimmer abandoned his goal of swimming the English Channel.

Gradually, however, the swimmer began to feel better. His shingles resolved completely, and the missing crown on his exposed tooth was replaced. In May 2013, he decided to resume his quest for a solo English Channel crossing and began training both in a pool with a local masters swim group and individually in open water.

In September 2013, the swimmer twice attempted a solo English Channel crossing. He was unsuccessful, spending over 12 hours in the water during each attempt and retiring from each with signs of mild hypothermia and generalized fatigue.

In November 2013, the swimmer was honored at the Dolphin Club’s yearly awards banquet. He received the Polar Bear award for most miles in 2012/2013. He was also awarded the Dolphin Club’s award for most inspirational swimmer. In early 2014, the swimmer moved to Saipan, where he continues to swim in open but warmer water. He continues to visit the Bay Area 2-3 times per year and swims in the San Francisco Bay during these visits.
DISCUSSION

Readers are invited to imagine swimming without a wetsuit, on average 4 miles per day, day after day, in cold open water (frequently with temperatures near 10° C (50 °F)), for an entire winter. Even elite swimmers would likely find this challenge to be daunting.

To make matters even more challenging, because of work obligations during the winter months, the swimmer swam much of the time in total pre-dawn or post-dusk darkness. Daylight swimming became more common toward the end of the event period, but the swimmer contracted painful shingles and suffered from tooth pain related to a lost crown. Clearly, persistence and fortitude were needed for this event.

In prior studies, an increased tolerance of cold has been associated with increased size and increased body fat (4-7,11,17,18). Yet our swimmer’s body composition parameters were not remarkable. Overall he had a normal BMI (1,22) and % body fat below the 50th percentile for age (1). How then was he able to endure repeated exposure to cold water?

A distinction is often made between 1. cold shock, 2. cold incapacitation and swim failure, and 3. true core hypothermia (5,6). Our swimmer was at risk for all three.

Cold shock refers to a series of reflex reactions after entry into cold water, resulting in intense hyperventilation, tachycardia, and elevated blood pressure (5-7). These responses involve nervous system reflexes and are not merely psychological (6,7,12). Typically, the maximal hyperventilation and tachycardia of cold shock lasts for less than 5 minutes (5-7). Acclimatization from repeated cold exposure results in blunting of reflexes and yields protection against cold shock (6,7). Thus, compared to a non-acclimatized individual, our swimmer likely had a performance advantage, particularly in the first minutes after cold-water entry.

Cold shock is followed by cold incapacitation and swim failure (5-7,20). Cold incapacitation and swim failure results from muscular fatigue, which occurs sooner in cold water than in warm water, and depending on the water temperature and swimming ability of the individual, occurs from minutes to over an hour after water entry (5-7,20). Because our swimmer wisely limited time in the water, it is unclear to what extent he was protected from cold incapacitation, although extensive swim training may have provided some benefit.

Lastly, true core hypothermia refers to a decline in core body temperature, which is related to water temperature and often takes several hours to develop (5-7). In the conditions our swimmer encountered in the San Francisco Bay, (e.g., 10° C (50° F) water), the initial stages of mild hypothermia would not be expected to begin until after approximately 30 minutes of immersion (6), and the overall survival time (until critical hypothermia) for an average individual without a wetsuit but with flotation is typically estimated to be in the range of 2-4 hours (6,7). Although acclimatization may yield some minor core temperature benefits (4), large size and an increase % body fat are key protective variables and have been associated with a
slower decrease in core temperature and protection against true core hypothermia (4-7,11,17,18). Because our swimmer’s size and % fat were not elevated, he likely had little physical protection from true core hypothermia, despite his extensive and repeated exposure. Thus, limiting time in the water was crucial for the overall success of our average-sized swimmer.

Some swimmers are remarkably efficient and able to generate substantial amounts of heat for extended periods (7) and, therefore, may be able to delay cold incapacitation and core hypothermia to a limited extent. English Channel swimmers, for example, are often lean and swim for periods substantially longer than predicted by survival tables (7). However, during most English Channel attempts (which occur in the summer or fall), the water temperature is typically warmer (e.g., 14 °C (57.2 °F)) than the colder temperatures our swimmer encountered in the San Francisco Bay during the winter (e.g., 10 °C (50 °F)).

In very cold water, even elite swimmers could have difficulty generating enough heat to overcome the dramatic heat loss associated with colder water temperatures. Our swimmer was not in an elite swimming category and wisely limited his time in cold water, and we did not measure his core body temperature in this study. We are therefore cautious about any firm conclusions regarding his ability to generate substantial heat as a form of protection against either cold incapacitation or true core hypothermia.

Thus, based on prior literature (4-7,11,17,18), our swimmer likely had little or minimal physical protection from true core hypothermia because his size and % fat were not elevated. He likely did have at least some protection from cold shock (5-7,12), resulting from acclimatization – causing blunting of the hyperventilation and tachycardia reflexes of cold shock (6,7). And because he was not an elite swimmer and sensibly limited his time in cold water (and because we did not test the limits of his endurance), it remains unclear to what extent he was protected from the muscle fatigue of cold incapacitation and swim failure (5-7,20).

In summary, we stress that careful limiting of time in cold water was the single most important factor in our swimmer’s success; by judiciously limiting his swim times, he was able to greatly decrease the risks of true core hypothermia and cold incapacitation. Acclimatization from repeated cold exposure yielded some protection against cold shock (6,7) but was likely of secondary benefit.

Although limiting time in cold water was crucial, and acclimatization likely provided some performance benefits, other factors may have also contributed to our swimmer’s overall success at winter swimming without a wetsuit. The swimmer carefully checked the tide and water conditions prior to each swim and used tidal currents to his advantage. Access to warm showers and a sauna allowed for pre-swim warming and more rapid rewarming after swims. As we mentioned above, the swimmer was grateful to other club members who offered encouragement and support.
Prior studies have suggested that repeated cold exposure may increase potentially beneficial and heat-producing brown fat (also referred to as brown adipose tissue (BAT)) (9). Brown fat measurement requires sophisticated equipment and radiation; we did not measure brown fat in our swimmer and thus cannot comment directly about its potential benefit in this case. To date, however, brown fat has not been measured in a large group of cold-water swimmers, and its potential benefits to cold-water swimming in general remain unproven. A wide variety of health benefits have been attributed to swimming in cold water including improved immunity, decreased depression and improved mood, improved glucose and hormonal regulation, and increased longevity (13,14,18). However, studies supporting these benefits have been largely suggestive and not conclusive, are partially contradicted by other studies, and typically have involved short swim distances. It is unclear how these studies apply to our swimmer who swam an extreme cumulative distance in rigorous conditions.

Our swimmer contracted severe shingles during the winter swim period, likely related to the considerable stress of his record-matching attempt. He reported depressed mood and at times even dread of swimming. His cholesterol and other components of a lipid profile did not change substantially, and he lost weight while not attempting to do so. We did not measure cytokines or other factors that have been measured in prior studies of winter swimming (14). However, from the data we did obtain, no clear health benefits attributable specifically to winter swimming (13,14,18) were observed in this extreme event.

What is clear is that the swimmer accomplished his swimming goal of a record-matching Polar Bear Challenge swim. His success was likely related to a combination of experience, acclimatization, access to warm showers and saunas, mental fortitude, and most importantly, to a swim strategy that limited time in the water per swim. A low resting heart rate with a normal blood pressure suggests that swimming contributed to general cardiovascular fitness. Although he did not accomplish his additional goal of a solo English Channel swim, he remains fit and continues to enjoy recreational swimming today. Given the nature of the event and the intense dedication required, it is not surprising that the swimmer won the Dolphin Club’s annual award for the most inspirational swimmer.

**CONCLUSION**

Our swimmer had generally normal biophysical parameters. Because he was relatively lean, he likely did not have substantial protection from core hypothermia. Rather, his ability to swim in cold water was related to a combination of experience, acclimatization, access to warm showers and a sauna, mental fortitude, and a swim strategy that limited time in the water per swim. Careful limiting of time in cold water was the single most important factor in our swimmer’s success; by judiciously limiting his swim times, he was able to greatly mitigate the risks of true core hypothermia and cold incapacitation.
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