

# RESEARCH

## THIS WEEK'S RESEARCH QUESTIONS

- 1284** What should you drink with a cheese fondue—white wine or black tea, and is a shot of schnapps good for the digestion?
- 1286** Is the Danish belief that submerging your feet in alcohol can make you drunk merely an urban myth—or is there some truth in it?
- 1287** Can you tell just by looking at someone that they're sleep deprived?
- 1289** Which popular children's toy provides symptomatic relief for ocular neuromyotonia, and why?



DUNCAN SMITH

# Effect on gastric function and symptoms of drinking wine, black tea, or schnapps with a Swiss cheese fondue: randomised controlled crossover trial

Henriette Heinrich,<sup>1</sup> Oliver Goetze,<sup>1</sup> Dieter Menne,<sup>2</sup> Peter X Iten,<sup>3</sup> Heiko Fruehauf,<sup>1</sup> Stephan R Vavricka,<sup>1</sup> Werner Schwizer,<sup>1,4</sup> Michael Fried,<sup>1,4</sup> Mark Fox<sup>1,4</sup>

## EDITORIAL by Annas

<sup>1</sup>Division of Gastroenterology and Hepatology, University Hospital Zurich, Switzerland

<sup>2</sup>Menne Biomed, Tuebingen, Germany

<sup>3</sup>Division of Legal Medicine, University Zurich, Switzerland

<sup>4</sup>Zurich Integrative Human Physiology Group, University of Zurich

**Correspondence to:** M Fox, NIHR Biomedical Research Unit, Nottingham Digestive Diseases Centre, Queen's Medical Centre, Nottingham NG7 2UH, UK  
dr.mark.fox@gmail.com

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**OBJECTIVE** To compare the effects of drinking white wine or black tea with Swiss cheese fondue followed by a shot of cherry schnapps on gastric emptying, appetite, and abdominal symptoms.

**DESIGN** Randomised controlled crossover study.

**PARTICIPANTS** 20 healthy adults (14 men) aged 23-58.

**INTERVENTIONS** Cheese fondue (3260 kJ, 32% fat) labelled with 150 mg sodium <sup>13</sup>C-octanoate was consumed with 300 ml of white wine (13%, 40 g alcohol) or black tea in randomised order, followed by 20 ml cherry schnapps (40%, 8 g alcohol) or water in randomised order.

**MAIN OUTCOME MEASURES** Cumulative percentage dose of <sup>13</sup>C substrate recovered over four hours (higher values indicate faster gastric emptying), and appetite and dyspeptic symptoms (visual analogue scales).

**RESULTS** Gastric emptying was significantly faster when fondue was consumed with tea or water than with wine or schnapps (cumulative percentage dose of <sup>13</sup>C recovered 18.1%, 95% confidence interval 15.2% to 20.9% v 7.4%, 4.6% to 10.3%; P<0.001). An inverse dose-response relation between alcohol intake and gastric emptying was evident. Appetite was similar with consumption of wine or tea, but reduced if both wine and schnapps were consumed (difference -0.40, 95% confidence interval -0.01 to -0.79; P<0.046). No difference in dyspeptic symptoms was present.

**CONCLUSIONS** Gastric emptying after a Swiss cheese fondue is noticeably slower and appetite suppressed if consumed with higher doses of alcohol. This effect was not associated with dyspeptic symptoms.

**TRIAL REGISTRATION** ClinicalTrials.gov NCT00943696

## Introduction

The benefits of drinking alcohol with food, especially high fat and high energy meals such as cheese fondue, are conflicting. In Switzerland, some traditionalists demand that white wine is drunk with this classic dish, whereas others insist on only black tea. The debate after dinner turns to whether a shot of "spirits" will promote digestive comfort.

In studies using a variety of meals and drinks the evidence for the effects of alcohol on gastric emptying were inconsistent.<sup>1-5</sup> Similarly, alcohol has complex effects on appetite and the likelihood of abdominal discomfort after a meal.<sup>6</sup> Critically, only one study has assessed both gastric function and symptoms after alcohol ingestion<sup>4</sup> and none considered the effects of alcohol consumed with a high energy, high fat meal. We compared the effects of white wine, black tea, and cherry schnapps on gastric emptying and abdominal symptoms after ingestion of a Swiss cheese fondue in healthy volunteers.

## Methods

We tested 20 healthy volunteers (14 men, aged 23 to 58) on two days, at least one week apart. None had a history of

alcohol misuse or gastrointestinal disease. None was taking prescription drugs.

After fasting for at least six hours, the participants ingested 200 g of Swiss cheese fondue (3260 kJ, 64 g fat, 2 g carbohydrate, 52 g protein); 50% Gruyere, 50% Fribourgeois (Moite-Moite Fondue, Coop, Basel, Switzerland) labelled with 150 mg sodium <sup>13</sup>C-octanoate. The cheese, heated using individual rechauds, was consumed with 100 g of bread (418 kJ). During the meal the participants drank 300 ml of either white wine (Fendant de Valais (Coop, Basel), 40 g of alcohol, 13% by volume) or black tea according to randomisation. At 90 minutes according to a second randomisation the participants drank 20 ml of either cherry schnapps (Etter Kirsch, Zug, Switzerland, 8 g of alcohol, 40% by volume) or water.

Before the meal and every 10-15 minutes for four hours we collected samples for breath testing. We measured the ratio of <sup>13</sup>C to <sup>12</sup>C in the samples using a spectroscopic method (see [bmj.com](http://bmj.com)). The proportion of substrate metabolised and exhaled was expressed as the maximal percentage dose of <sup>13</sup>C recovered per hour and the cumulative percentage dose recovered for each time interval.<sup>7,8</sup> Additionally, we used the reversed retention curve to estimate the half times for gastric emptying.<sup>7</sup>

Alcohol in breath was assessed before the meal and every 15 minutes for four hours using a standard breath test device (Draeger, Luebeck, Germany).

We used a 100 mm visual analogue scale to assess appetite (hunger, satiety, desire to eat, quantity to eat) before the meal and every 15 minutes for four hours. Similarly, we used a visual analogue scale to assess dyspeptic symptoms, nausea, bloating, and abdominal discomfort.

## Statistical analysis

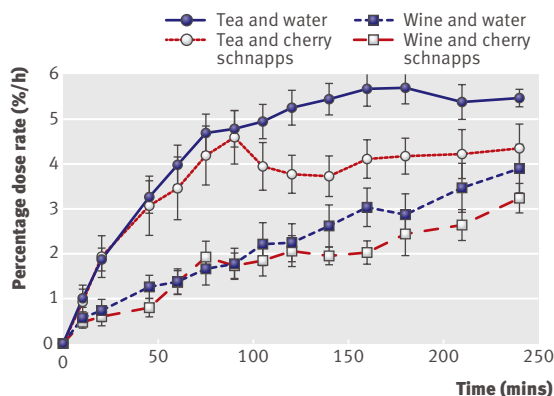
Gastric emptying was evaluated by the cumulative percentage dose of <sup>13</sup>C recovered after each time interval.<sup>7</sup> To normalise the scores for appetite we subtracted the group mean score and then divided by the group standard deviations. A correction was applied for multiple pairwise comparisons.

## Results

From early during the meal and throughout the study the recovery curves for <sup>13</sup>C were lower for wine than for tea, indicating slower gastric emptying. In addition, the recovery rate decreased immediately after ingestion of schnapps, which was most evident in association with tea (figure).

Gastric emptying was significantly faster when fondue was consumed with tea or water than with wine or schnapps (18.1%, 95% confidence interval 15.2% to 20.9% v 7.4%, 4.6% to 10.3%; P<0.001); gastric emptying half times 361 minutes (95% confidence interval 314 to 408 minutes) and 560 minutes (514 to 607 minutes), respectively. Gastric emptying was faster if fondue was consumed with tea rather than with wine, whether schnapps was consumed (increased cumulative recovery 95% confidence interval 2.9% to 11.0%;





Gastric emptying measured as average percentage dose recovery of carbon 13 (error bars show standard errors) after ingestion of cheese fondue taken with white wine or black tea followed by a shot of cherry schnapps

$P < 0.002$ ) or not (4.1% to 12.2%;  $P < 0.001$ ). Schnapps also tended to slow gastric emptying, especially when consumed after tea (decreased cumulative recovery  $-3.6\%$ ,  $0.4\%$  to  $-7.7\%$ ;  $P < 0.075$ ), equivalent to an increased gastric emptying half time of 80 minutes (95% confidence interval 15 to 145 minutes). An inverse dose-response relation between alcohol intake and gastric emptying was evident (see [bmj.com](http://bmj.com)).

Ingestion of fondue increased fullness and decreased the appetite score by 0.33 (95% confidence interval 0.03 to 0.63;  $P < 0.032$ ). There was no correlation between appetite score and rate of gastric emptying. Five participants reported moderate (visual analogue scale score  $> 3$ ) dyspeptic symptoms (nausea, bloating, discomfort). Only one participant reported more severe (score  $> 6$ ) symptoms.

## Discussion

The debate about what to drink with a cheese fondue is one about which everyone at the Swiss dinner table has an opinion. Our results show that drinking white wine with this high fat, high energy meal decreases the rate of gastric emptying compared with black tea. Taking a shot of spirits after the meal has additional gastrointestinal effects. At the highest doses studied, alcohol seemed to suppress appetite after the meal; irrespective of beverage, dyspeptic symptoms were reported only occasionally.

We observed an important decrease in gastric emptying rate when a moderate amount of white wine (300 ml; 14% alcohol) was consumed with a Swiss cheese fondue compared with the same volume of black tea. The decrease was rapid and prolonged, with the recovery of  $^{13}\text{C}$  reduced from the first breath sample and never attaining the level of the control arm (figure). This finding is consistent with reports that ethanol and a variety of alcoholic beverages slow gastric emptying when taken before a meal<sup>3-5</sup>; although, this effect was not always observed if the total energy content of food and drink consumed during the meal was controlled.<sup>1,2</sup>

A shot of schnapps (20 ml; 40%) also reduced the rate of gastric emptying. The effect was rapid, with an immediate decrease in  $^{13}\text{C}$  recovery after intake (figure). It is inconceivable that a small volume of spirits could “bypass” the meal in the distal stomach quickly enough to exert such rapid effects through feedback from nutrient receptors in the small bowel. Although a trend relating alcohol concentration and gastric

emptying rate was evident (see [bmj.com](http://bmj.com)), we found no correlation between the concentration of alcohol in the breath and the effects on gastric emptying. Together these findings indicate that alcohol has direct, rather than indirect or systemic effects, on stomach function.

The effects of alcohol on appetite and abdominal symptoms are complex, depending on the timing, quantity, and other characteristics of the drink and the meal.<sup>6-11</sup> In this study alcohol suppressed appetite, but this was apparent only at the highest concentration (48 g alcohol consumed as wine and schnapps). Although the energy density of alcohol is second only to that of fat, its effect on satiation seems to be less than that of other macronutrients.<sup>6</sup>

We found no association between beverage consumed during the meal and dyspepsia after the meal. Alcohol promotes gastric relaxation but delays gastric emptying. As a consequence, drinking white wine and schnapps with a Swiss cheese fondue may provide short term relief of postprandial dyspepsia; however, this may come at the cost of more prolonged fullness and reflux.

Connoisseurs might point out that wine or schnapps is often added to fondue; this would not confound the results because, as noted by a cookbook writer, alcohol boiled at  $78^\circ\text{C}$  will have evaporated after 20-30 seconds.<sup>12</sup> Healthy readers should be reassured that they can continue to enjoy fondue with the beverage of their choice without concerns about postprandial digestive comfort.

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**Ethical approval:** This study was approved by the Zurich University Hospital research ethics committee.

**Data sharing:** Full study data including statistical analysis and technical appendix are available from the corresponding author at [dr.mark.fox@gmail.com](mailto:dr.mark.fox@gmail.com).

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Join the authors at a fondue party as they explain their research at [bmj.com/video](http://bmj.com/video)

# Testing the validity of the Danish urban myth that alcohol can be absorbed through feet: open labelled self experimental study

Christian Stevns Hansen, Louise Holmsgaard Færch, Peter Lommer Kristensen

## EDITORIAL by Annas

Endocrinology Section,  
Department of Cardiology and  
Endocrinology, Hillerød Hospital,  
Dyrehavevej 29, DK-3400 Hillerød,  
Denmark

Correspondence to: P.L. Kristensen  
pelk@hih.regionh.dk

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**OBJECTIVE** To determine the validity of the Danish urban myth that it is possible to get drunk by submerging feet in alcohol.

**DESIGN** Open labelled, self experimental study.

**SETTING** Office of a Danish hospital.

**PARTICIPANTS** Three adults, median age 32 (range 31-35).

**MAIN OUTCOME MEASURES** Primary end point was concentration of plasma ethanol (detection limit 2.2 mmol/L (10 mg/100 mL)), measured every 30 minutes for three hours with feet submerged in 2100 mL of vodka. The secondary outcome was self assessment of intoxication related symptoms: self confidence, urge to speak, and number of spontaneous hugs.

**RESULTS** Plasma ethanol concentrations were below the detection limit of 2.2 mmol/L (10 mg/100 mL). No significant changes were observed in intoxication related symptoms, although self confidence and urge to speak increased slightly at the start of the study.

**CONCLUSION** Our results suggest that feet are impenetrable to the alcohol component of vodka. We therefore conclude that the Danish urban myth of being able to get drunk by submerging feet in alcoholic beverages is just that; a myth.

## Introduction

According to Danish urban folklore, it is possible to get drunk by submerging feet in alcoholic beverages. We determined whether alcohol can be detected in the circulation after submersion of feet in vodka.

## Methods

The study was open labelled and self experimental. It evaluated the effect of submerging feet in 2100 mL of vodka on plasma ethanol concentration. Secondary end points were intoxication related symptoms.

Three adults (CSH, LHF, and PLK) agreed to participate (see characteristics on *bmj.com*). None had any skin or liver disease or was dependent on alcohol or psychoactive drugs, or had been implicated in serious incidents or socially embarrassing alcohol related events in the week before the experiment.

The participants abstained from alcohol 24 hours before the experiment. The evening before the experiment they exfoliated their feet with a loofah. On the day of the experiment, a baseline blood sample was taken. The participants then submerged their feet in three 700 mL bottles' worth of vodka (Karloff vodka; M R Štefánika, Cífer, Slovakia, 37.5% by volume). Plasma ethanol concentrations were determined every 30 minutes for three hours using a photometric method, with a detection limit of 2.2 mmol/L (10 mg/100 mL, 0.010% weight/volume). Participants recorded intoxication related symptoms (self confidence, urge to speak, and number of spontaneous hugs) on a scale from 0 to 10.

The main results are presented as medians (ranges). We planned a paired *t* test to compare baseline and maximum val-

ues of plasma ethanol concentrations and intoxication related symptoms. The level of significance was 5%, two sided.

## Results

Plasma ethanol concentrations were below the detection limit of 2.2 mmol/L (10 mg/100 mL). The figure presents the intoxication related symptoms. Changes were not significant.

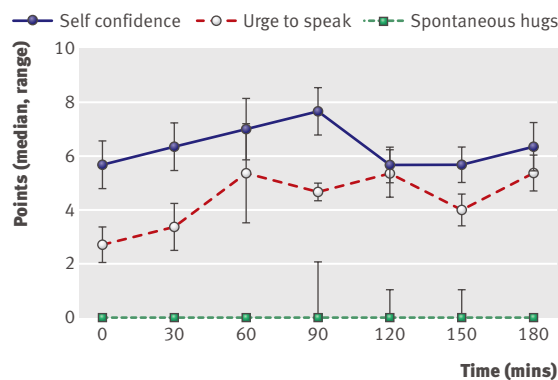
## Discussion

Our results suggest that the transcutaneous uptake of alcohol (vodka, 37.5% by volume) through feet is not possible. We therefore conclude that the Danish urban myth about being able to get drunk by submerging feet in alcohol is just that; a myth.

The limited number of participants is a weakness of this study. However, the frequent measurements of alcohol concentrations, a three hour study period (corresponding to a medium length visit to the pub), and clear data make the results credible. Moreover, the results are in accordance with a study in which no transcutaneous absorption of alcohol was observed after multiple use of an ethanol based hand sanitiser.<sup>2</sup>

As the implications of the study are many, we will mention a few. Driving with boots full of vodka seems to be safe. Brewery workers cannot become intoxicated by "falling" into a vat. Importantly, students experimenting with transcutaneous alcohol absorption should move on to more relevant activities.

Many questions are still to be answered in the research specialty of alcohol transport across non-gastrointestinal barriers. This study has shown that feet are impenetrable to the alcohol component of Karloff vodka. Other stronger beverages, beetroot juice, or combinations of juices and alcoholic beverages may, however, cross the epithelial barrier of the skin. Moreover, new pastimes, such as "eyeball drinking," have emerged. The significance of this activity is unknown. Rumour has it that it makes you drunk quickly . . . and may damage your eyes.



Self assessed (arbitrary scale 0-10) intoxication related symptoms (self confidence, urge to speak, and spontaneous hugs) in three healthy volunteers (two men and one woman) while their feet were submerged in 2100 mL of vodka (37.5% by volume) for three hours



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**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author) and declare: no support from any company for the submitted work; no financial relationships with any companies that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

**Ethical approval:** Approval of the study at the local ethics committee was not attempted as this was self experimentation; all the participants were also authors.

**Data sharing:** No additional data available.

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## Beauty sleep: experimental study on the perceived health and attractiveness of sleep deprived people

John Axelsson,<sup>1,2</sup> Tina Sundelin,<sup>1</sup> Michael Ingre,<sup>3</sup> Eus J W Van Someren,<sup>4</sup> Andreas Olsson,<sup>1</sup> Mats Lekander<sup>2,3</sup>



<sup>1</sup>Osher Center for Integrative Medicine, Department of Clinical Neuroscience, Karolinska Institutet, 17177 Stockholm, Sweden

<sup>2</sup>Division for Psychology, Department of Clinical Neuroscience, Karolinska Institutet

<sup>3</sup>Stress Research Institute, Stockholm University, Stockholm

<sup>4</sup>Netherlands Institute for Neuroscience, an Institute of the Royal Netherlands Academy of Arts and Sciences, and VU Medical Center, Amsterdam, Netherlands

Correspondence to: J Axelsson [john.axelsson@ki.se](mailto:john.axelsson@ki.se)

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**OBJECTIVE** To investigate whether sleep deprived people are perceived as less healthy, less attractive, and more tired than after a normal night's sleep.

**DESIGN** Experimental study.

**SETTING** Sleep laboratory in Stockholm, Sweden.

**PARTICIPANTS** 23 healthy, sleep deprived adults (age 18-31) who were photographed and 65 untrained observers (age 18-61) who rated the photographs.

**INTERVENTION** Participants were photographed after a normal night's sleep (eight hours) and after sleep deprivation (31 hours of wakefulness after a night of reduced sleep). The photographs were presented in a randomised order and rated by untrained observers.

**MAIN OUTCOME MEASURES** Difference in observer ratings of perceived health, attractiveness, and tiredness between sleep deprived and well rested participants using a visual analogue scale (100 mm).

**RESULTS** Sleep deprived people were rated as less healthy (visual analogue scale scores, mean 63 (SE 2) v 68 (SE 2),  $P<0.001$ ), more tired (53 (SE 3) v 44 (SE 3),  $P<0.001$ ), and less attractive (38 (SE 2) v 40 (SE 2),  $P<0.001$ ) than after a normal night's sleep. The decrease in rated health was associated with ratings of increased tiredness and decreased attractiveness.

**CONCLUSION** Our findings show that sleep deprived people appear less healthy, less attractive, and more tired compared with when they are well rested. This suggests that humans are sensitive to sleep related facial cues, with potential implications for social and clinical judgments and behaviour. Studies are warranted for understanding how these effects may affect clinical decision making and can add knowledge with direct implications in a medical context.

### Introduction

Sleep has well established effects on physiological, cognitive, and behavioural functionality<sup>1-4</sup> and long term health,<sup>5</sup> but its role in social perception, such as that underlying judgments of attractiveness and health, is only anecdotal. To describe the relation between sleep deprivation and perceived health and attractiveness we asked untrained observers to rate the photographed faces of people after a normal night's sleep and after sleep deprivation.

### Methods

We photographed the faces of 23 adults between 14.00 and 15.00 after a normal night's sleep (23.00-07.00 and seven hours of wakefulness) and after sleep deprivation (02.00-07.00 and 31 hours of wakefulness).

Sleep times were confirmed with diaries, and by text messages sent at bedtime and on awaking (mean time in bed for the normal sleep condition 8.45 (SE 0.20) hours). The sleep deprivation condition started with a restriction of sleep to five hours in bed; the participants texted the time that they fell asleep and awoke (mean 5.06 (SE 0.04) hours). For the next night of sleep deprivation, the participants arrived at the sleep laboratory at 22.00 (after 15 hours of wakefulness) and stayed awake for a further 16 hours. For the sleep condition, participants came to the laboratory at 12.00 (after five hours of wakefulness).

For the photo shoot, participants were asked to look into the camera with a neutral, relaxed expression. A series of five or six photographs were taken (see [bmj.com](http://bmj.com)). The photographer was not blinded to the sleep conditions, but followed a standardised procedure, including minimal interaction with the participants. A blinded rater chose the most typical photograph from each series.

A month later the photographs were presented at intervals of six seconds in a randomised order to 65 observers (mean age 30 (range 18-61) years), who were unaware of the study

### WHAT IS ALREADY KNOWN ON THIS TOPIC

- Short or disturbed sleep and fatigue constitute major risk factors for health and safety
- Complaints of short or disturbed sleep are common among patients seeking healthcare
- The human face is the main source of information for social signalling

### WHAT THIS STUDY ADDS

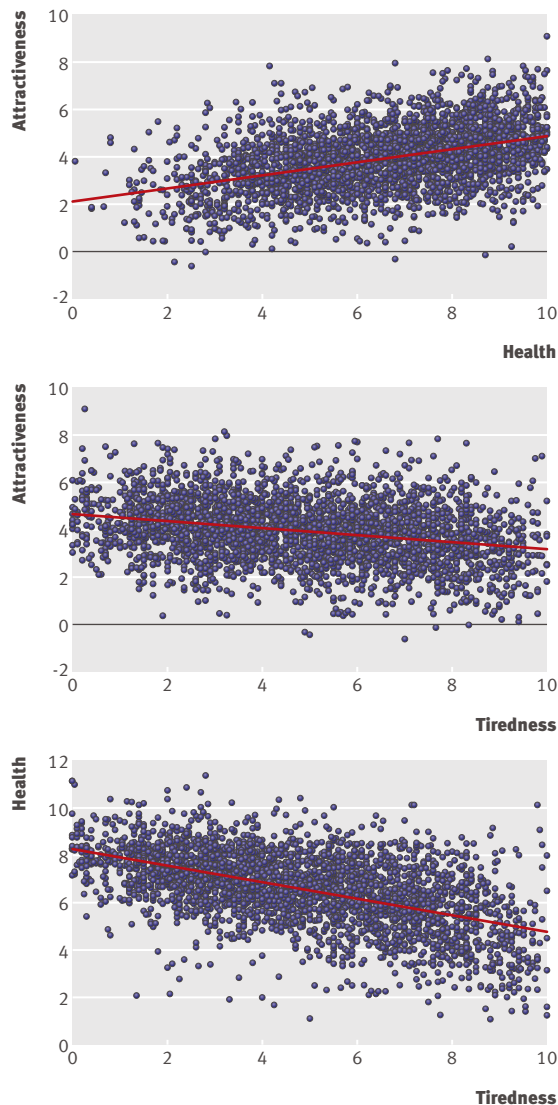
- The facial cues of sleep deprived people are sufficient for others to judge them as more tired, less healthy, and less attractive, lending the first scientific support to the concept of "beauty sleep"
- By affecting doctors' general perception of apparent health, the sleep history of a patient may affect clinical decisions and diagnostic precision

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Participant's face after a normal night's sleep (left) and after sleep deprivation (right)



Relations between health, tiredness, and attractiveness of 46 photographs (two each of 23 participants) rated by 65 observers on 100 mm visual analogue scales, with variation between observers removed using empirical Bayes' estimates

conditions. They rated the faces in three sessions, for attractiveness, health, and tiredness on a 100 mm visual analogue scale. To avoid the influence of possible order effects we presented the photographs in a balanced order between conditions for each session and allowed a brief intermission after every 23 photographs, including a working memory task for 23 seconds to prevent the faces being memorised.

### Statistical analyses

Data were analysed using multilevel mixed effects linear regression, with two crossed independent random effects accounting for random variation between observers and participants using xtmixed in Stata 9.2. We also present the effect of condition as the percentage change from baseline condition (reference) using the absolute value in millimetres (rated on the visual analogue scale).

### Results

When sleep deprived, people were rated as less healthy (visual analogue scale scores, mean 63 (SE 2) v 68 (SE 2)), more tired (53 (SE 3) v 44 (SE 3)), and less attractive (38 (SE 2) v 40 (SE 2);  $P < 0.001$  for all) than after a normal night's sleep (see [bmj.com](http://bmj.com)). Compared with the normal sleep condition, perceptions of health and attractiveness in the sleep deprived condition decreased on average by 6% and 4% and tiredness increased by 19%.

### Discussion

Sleep deprived people are perceived as less attractive, less healthy, and more tired compared with when they are well rested. Apparent tiredness was strongly related to looking less healthy and less attractive. That the untrained observers detected the effects of sleep loss in others provides evidence for a perceptual ability not previously subjected to experimental control, and supports the notion that sleep history gives rise to socially relevant signals that provide information about the bearer.

The results are related to photographs taken in an artificial setting and presented to the observers for only six seconds. It is likely that the effects reported here would be larger in real life situations, when overt behaviour and interactions add further information. Blink interval and blink duration are known to be indicators of sleepiness,<sup>6</sup> and trained observers are able to evaluate reliably the drowsiness of drivers by watching their videotaped faces.<sup>7</sup> In addition, a few of the people were perceived as healthier, less tired, and more attractive in the sleep deprived condition.

Our findings suggest a prominent role of sleep history in several domains of interpersonal perception and judgment, such as clinical judgment. In addition, because attractiveness motivates sexual behaviour, collaboration, and superior treatment,<sup>8</sup> sleep loss may have consequences in other social contexts. That good sleep supports a healthy look and poor sleep the reverse may be of particular relevance in the medical setting, where estimates of health are essential. It is possible that people with sleep disturbances, clinical or otherwise, would be judged as more unhealthy, whereas those who have had an unusually good night's sleep may be perceived as rather healthy.

### Conclusions

People are capable of detecting sleep loss related facial cues, and these modify judgments of another's health and attractiveness. These conclusions agree well with existing models describing a link between sleep and good health,<sup>9 10</sup> and attractiveness and health.<sup>8</sup>

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**Competing interests:** None declared.

**Ethical approval:** This study was approved by the Karolinska Institutet's ethical committee. Participants were compensated for their participation.

**Participant consent:** Participant's consent obtained.

**Data sharing:** Statistical code and dataset of ratings are available from the corresponding author at john.axelsson@ki.se.

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## Can he fix it? Yes, he can!

We present a case in which a novel treatment was instigated by the patient to control symptoms of ocular neuromyotonia

### Case report

A 68 year old woman presented with intermittent diplopia lasting a few minutes precipitated by left gaze. Best corrected visual acuities were 6/9 right and 6/36 left. Initial examination showed only a dense left cataract, which was removed, improving vision to 6/9. Unfortunately her symptoms continued. Her diplopia was elicited during orthoptic review, showing a left exotropia, with updrift, measuring 40 prism dioptres. There was limitation of adduction and depression of the left eye. Imaging showed no structural lesion. The episodes increased in frequency to 50-100 times per day. However, she found one day, while playing with her grandson, that wearing a pair of his tight "Bob the Builder" goggles prevented the episodes from occurring (figure).

As a result she took to wearing the goggles daily around the house, particularly to watch the television. She also tried other types of goggles, including swimming goggles, but these were not as effective. She was diagnosed with idiopathic ocular neuromyotonia affecting left lateral rectus and left superior rectus muscles. Symptom control was achieved with carbamazepine after a trial of gabapentin failed.

### Discussion

Ocular neuromyotonia, first described in 1970,<sup>1</sup> is characterised by transient diplopia and strabismus that occurs spontaneously or with maintenance of eccentric gaze, resulting in tonic contraction or spasm of ocular muscles.<sup>2</sup> It is a rare paroxysmal involuntary contraction that may affect one or more of the ocular motor muscles.

Sixth nerve myotonia is triggered by sustained action of the lateral rectus muscle, leading to intermittent exotropia with restriction of adduction.



In our patient the episodes of involuntary strabismus were triggered by lateral gaze. By wearing restricted field goggles that eliminated the stimulus for lateral gaze, the patient prevented these episodes

Ocular neuromyotonia is thought to result from spontaneous neural firing from a single neurone or group of neurones, with interneural transmission resulting in a self-perpetuating circuit.<sup>1 2</sup> Eliminating this mechanism with membrane stabilising agents can lead to resolution of symptoms.<sup>2</sup>

Our patient has identified a new mechanism for preventing episodes of ocular neuromyotonia, but carbamazepine has now stabilised her condition.

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**Kelly Weston** OST2, Royal Hampshire County Hospital, Winchester SO22 5DG, UK [weston.dr@gmail.com](mailto:weston.dr@gmail.com)

**Kate Bush** OST4, Royal Bournemouth Hospital, Bournemouth, UK

**Farid Afshar** specialist registrar, Moorfields Eye Hospital, London, UK

**Steven Rowley** consultant ophthalmologist, Royal Bournemouth Hospital, Bournemouth, UK

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