S.37

File With

SECTION 131 FORM

Appeal No: ABP—314485-22

Defer Re O/H:

Having considered the contents of the submission ~~dated~~/received 13/12/2023 from Bernardine Dempsey I recommend that section 131 of the Planning and Development Act, 2000 be/not be invoked at this stage for the following reason(s):

no new material issues

Section 131 not to be invoked at this stage. ✓

Section 131 to be invoked — allow 2/4 weeks for reply.

Signed: Pati Bu — Date: 21/12/2023

EO

Signed — Date

SEO/SAO

M

Please prepare BP — Section 131 notice enclosing a copy of the attached submission.

To — Task No — Allow 2/3/4 weeks: BP

Signed — Date

EO

Signed — Date

AA

An Bord Pleanála

Planning Appeal Online Observation

Online Reference
NPA-OBS-002923

Online Observation Details

Contact Name	Lodgement Date	Case Number / Description
Bernardine Dempsey	13/12/2023 18:37:58	314485

Payment Details

Payment Method	Cardholder Name	Payment Amount
Online Payment	Bernardine Dempsey	€50.00

Processing Section

S.131 Consideration Required

☑ Yes — See attached 131 Form ☐ N/A — Invalid

Signed Karen Byrne
EO

Date 15/12/2023

Fee Refund Requisition

Please Arrange a Refund of Fee of €

Lodgement No LDG— 066788-23

Reason for Refund

Documents Returned to Observer ☐ Yes ☐ No

Request Emailed to Senior Executive Officer for Approval ☐ Yes ☐ No

Signed
EO

Date

Finance Section

Payment Reference ch_3OMxJhB1CW0EN5FC1swFplrJ

Checked Against Fee Income Online
EO/AA (Accounts Section)

Amount €

Refund Date

Authorised By (1)
SEO (Finance)

Authorised By (2)
Chief Officer/Director of Corporate Affairs/SAO/Board Member

Date

Date

An Bord Pleanála Case No:	PL06F.314485
Planning Application:	F20A/0668
Planning Authority:	Fingal County Council
Development Location:	Dublin Airport
Name:	Bernardine Dempsey
Address:	Wheatfield, Ballyboughal, Co Dublin

I would like to object to the proposed relevant action F20A/066 made by the DAA and request that you enforce the An Bord Pleanála conditions of the planning permission PL 06F.217429 granted for the development of North Runway.

Flightpaths and Noise Contours:

The flightpaths and noise contours presented in the DAA's EIAR supplement (in response to An Bord Pleanála's Request) are materially different from those approved in the application for the North Runway EIS 2004 -2007 Option 7b. and Noise Abatement & Flight Procedures in the North Runway Planning Permission (ABP Ref. No.: PL06F.217429) documentation. See extract below:

"6.2.4 Aircraft of Categories C/D (medium to heavy jets) departing to the west (Runway 28) are required to maintain straight ahead after take-off to 5NM before commencing turn, unless otherwise cleared by ATC above 3000 feet.

6.2.5 Aircraft of Categories C/D (medium to heavy jets) departing to the east (Runway 10) are required to maintain straight ahead after take-off to 5NM before commencing turn (if turning left), and 6NM (if turning right), unless otherwise cleared by ATC above 3000 feet. The disparity here is to ensure that southbound aircraft do not over-fly Howth Head. Northbound aircraft will turn over the sea thereby avoiding the communities of Portmarnock and Malahide."

Speaking to *The Journal*, Minister O'Brien – who is a TD for the Fingal area where the airport is located – said it is his view that the airport is "using flight paths that weren't agreed".
"You can't go outdoors at the moment in some areas," O'Brien said, referring to the noise of overhead planes".
https://www.thejournal.ie/dublin-airport-flight-path-darragh-obrien-6188414-Oct2023/?utm_source=twitter_short

These new unapproved flightpaths currently being used and presented in the DAA EIAR supplement are based on aircraft turning before the 5NM and 3000 feet limits. This has resulted in intolerable noise problems for thousands of residents in North County Dublin who were not included in the original planning.
Areas such as Ashbourne are being overflown by aircraft causing aviation noise in the region of 60 to 70 dBA, are not included in any insulation scheme. This in breach of condition 6 of Planning Permission (ABP Ref. No.: PL06F.217429).

No consultation has taken place with the residents of the overflown areas in the unapproved flightpaths and noise monitoring is not fully in place along the new flightpath. This would appear to be in breach of condition 10 of Planning Permission (ABP Ref. No.: PL06F.217429).

As a result of the intolerant noise being created by the DAA unapproved flightpaths, there has been public protest and complaints to the DAA, Fingal County Council and local TDs. Based on this An Bord Pleanála should consider opening the current appeal to an oral hearing given the gravity of the situation.

It would appear that through this relevant action request, the DAA are consciously and deliberately trying to retain unapproved flightpaths without the prerequisite noise insulation abatement measures, consultation and appropriate planning permission. I would request that you consider this when making your decision as it will lead to an intolerant noise for residents along the flight path.

Night Flights:

An Boad Pleanála restricted the quantity of night flights to 56 per night and made a condition that the North runway should not be used between the hours of 11pm and 7am, in order to ensure that there would be no deterioration in noise conditions at night, per the decision on the planning application by the DAA (Fingal County Council Reg. Ref. No. F04A/1755; ABP Ref. No. PL06F.217429).

There have been numerous news articles on the subject and an RTE Prime Time programme on the noise problems caused by the DAA change to flightpaths.

The DAA in conjunction with ANCA are planning to amend operating conditions per the DAA planning application (F20A/0668) to allow night flights while introducing a new noise quota system based on average noise levels without a cap on the number of flights (movements) per night.
They will allow a noise quota annual limit of 16,260, which can result in a very large number of flights on any given night.

Normal practice is to have a limit on flights (movements) per annum or per night as you can see from the table below of major European hub airports and an extract from UK Department of Transport night flight restrictions.

Night flight policies on major European hub airports:

	Operating ban for noisy aircraft	Noisetax or c harge	Restrictionon the number of night flights
CDG (Charles de Gaulle)	Yes	Yes	No, but a maximum of 55 between 00h00and 04h59
LHR (Heathrow)	Yes	Yes	Yes: 16 per night from 23h30-06h00
AMS (Schiphol)	Yes	Yes	Yes: 88 per night (23h00-07h00), maximum of 49 per hour
FRA (Frankfurt)	Yes	Yes	Yes: 133 per night, no flights between 23h00 and 05h00

Night flight restrictions at Heathrow, Gatwick and Stansted,

Decision Document Moving Britain Ahead from the Department for Transport in the UK. Night flight restrictions - GOV.UK (www.gov.uk) :

"Set a two-year regime, from October 2022 to October 2024. During this period, we intend on keeping the existing movement and noise quota allowances that are in place at the designated airports". These are set out below:

Airport	Seasonal Period	Movement Limit	Noise Quota Limit
Heathrow	Winter	2,550	2,415
	Summer	3,250	2,735
Gatwick	Winter	3,250	1,785
	Summer	11,200	5,150
Stansted	Winter	5,600	3,310
	Summer	8,100	4,650

I would request that you do not approve the DAA application to remove the 65 / night limit on flight per condition 5 of planning permission PL 06F.217429 granted for the development of North Runway. Please maintain condition 3d to restrict the use of the North runway 10L-28R between 2300 and 0700 hours in order to prevent an escalation in noise problems in North County Dublin.
Also, please consider and comment on why ANCA has agreed to do this against the background of the current protect against the noise level in North County Dublin and in light of what other European airports do in relation to night flight caps.

The DAA have been in breach of the 65 flights per night limit which has resulted in an enforcement notice and High Court case. If An Bord Pleanála decided on this application prior to completion of the High Court case, there is a possibility that your decision may affect the outcome of the case.

Airport Capacity:

An Bord Pleanála Reference Number: PL 06F.220670 Condition 2 states:

"The combined capacity of Terminal 2 as permitted together with Terminal 1 shall not exceed 32 million passengers per annum unless otherwise authorised by a further grant of planning permission".

The DAA exceeded this condition in 2019 and are likely to exceed it again in 2023 unless planning conditions are enforced.

Currently the DAA count transit and transfer passenger arrival and departure as one count as opposed to two counts.
The CSO states "Transit passengers are included and are counted twice (i.e., both as arriving and departing passengers)" in their statistics. This means that the DAA are likely to exceed the 30 million passenger per annum limit again this year if you take a reasonable interpretation of the PL 06F.220670 Condition 2.

Approving a change to increase the hours for daytime operation of the North runway will result in increasing capacity and will give the DAA the ability to exceed their regulatory limit of 30M passengers. This is detrimental to the residents of North County Dublin and puts extra pressure on

the services (such as Garda, bus service and road maintenance) while at the same time overloading existing infrastructure (such as Terminals, roads to the Airport and carparks). Why would any reasonable manager or neighbour do this.

Economic Impact:

Per CSO Statistics for 2022 Dublin airport handled 84% of all flights. For freight Dublin airport handled approx. 88% of all freight. See extracts below from the CSO site.

Aviation Statistics Quarter 4 and Year 2022 - CSO - Central Statistics Office

"Over 236,000 flights were handled by Ireland's five main airports in 2022, with Dublin handling 84% of all flights (199,464), while Cork handled 7% of all flights (16,592)."

Table 9: Air freight classified by arrivals and departures handled by main airports, Quarter 4 and Year 2022

Tonnes

	Quarter 4	January to December
Arrival		
Cork	5	25
Dublin	19,026	74,965
Kerry	0	0
Knock	2	4
Shannon	2,268	9,512
Total arrivals - freight[1]	**21,300**	**84,506**
Departure		
Cork	0	2
Dublin	17,981	67,417
Kerry	0	0
Knock	0	0
Shannon	1,881	7,661
Total departures - freight[1]	**19,862**	**75,080**
All		
Cork	5	26
Dublin	37,006	142,382
Kerry	0	0
Knock	2	4
Shannon	4,149	17,1

Based on the above there is a huge imbalance in Airport usage across Ireland with Dublin airport having a disproportionate share of the market.

Dublin Airport Operating Restrictions September 2023 – Addendum v1.0 Quantification of Impacts on Future Growth Addendum to the Analysis of June 2021 (Report version 1.3.1) advise that:

"As overall DUB traffic recovers to 2019 pre-pandemic levels, demand for night flights is expected to be higher at 133 movements by 2025 (+15%). This is due mainly to growth in night cargo flights."

It does not consider the wider business opportunity for reginal airports for night flight business.

If the current night flight cap of 65 flights is retained it may present an opportunity to address some of the huge imbalance between Dublin Airport and the regional airports.

Also, it does not consider the wider global environment for example:
"In July 2021, the European Commission released the 'Fit for 55' package, which includes a set of policy proposals spanning all major sectors of the economy to achieve emission reductions of at least 55 per cent below 1990 levels in 2030. The 'Fit for 55' package includes a proposal for amending the ETS Directive, which would eliminate free ETS allowances allocated to the aviation sector by 2026".

From <https://www.gov.ie/pdf/?file=https://assets.gov.ie/207239/55a2a58a-6e17-431c-9b28-9fec09e0e82f.pdf#page=null>

What impact will the elimination of the free Emissions Trading System (ETS) allowances and subsequent cost increases have on DAA forecast for demand. Will the quantity of flights increase or decrease at night. Will IAG (Aer Lingus) and Ryanair in the short term try to push more low-cost flights into Dublin to avoid fees and taxes that are currently being introduced across Europe.
Will the DAA increase the quantity of night flights and early morning flights. Will this lead to a huge number of flights from the North Runway during the additional 2 hours being requested by the DAA.

I see no valid reason for the residents of North County Dublin to lose an additional 2 hours sleep in order to facilitate low-cost flights by IAG and Ryanair. And I would ask you to consider if these companies would really move to higher cost airports with similar restrictions to Dublin if they do not get their way.

Sleep Impact:

The largest body of research concentrated on the opening and closing of runways, leading to subsequent changes in flight paths (Breugelmans et al., 2007; Brink et al., 2008; Fidell et al., 2002). It showed that changes in noise exposure as a consequence of rearrangement of flight paths, step changes or increase or removal of over-flights resulted in statistically significant changes of the annoyance ratings of residents living in the vicinity of airports.

In response to the Prof. Dr. Thomas Penzel report on awakenings as a response to noise during sleep provided by the DAA.
As Matt Walker Sleep scientist, professor, author states "Sleep, unfortunately, is not an optional lifestyle luxury. Sleep is a non- negotiable biological necessity". See appendix 1 for details.

Conclusion:

The DAA is a bad neighbour in the opinion of most people living near Dublin Airport.
The current DAA board have demonstrated a failure to meet their fiduciary duty, they are not showing good faith in making this application and have breached planning conditions by:

- Exceeding the overall capacity limit of 30M passengers resulting in pressure on services and infrastructure around the airport.
- Exceeding night flight limits of 65 per night, resulting in a court case.
- Changing flightpaths and consequently noise contours without planning permission.
- Misleading the public and government bodies by their interpretation of passenger numbers and excluding transit and transfer passengers from their counts.
- Misleading or partial informing ANCA of noise levels along their unapproved flight path.
- Having not conducted an insulation programme to affected residents along the unapproved flightpath (leaving the DAA open to court cases).
- Eligibility to the insulation scheme shall be **reviewed every 2 years commencing in 2027** with residential dwellings situated in the 55 dB Lnight contour being eligible under the scheme. A period of 2 years is unreasonable for residents affected by noise levels. This should be reviewed yearly, especially as the DAA will be growing rapidly with a plan to increase their capacity from 32M to 40M in the coming years.
- Colluding with Ryanair and IAG to put pressure on public bodies through their scare campaign about flights moving from Dublin.

An Bord Pleanála have shown wisdom in applying restrictions and condition to DAA planning to protect the public. I trust in your decision concerning this DAA application.

Appendix 1 Extract of TED presentation from Matt Walker on the importance of Sleep.

Matt Walker
Sleep scientist, professor, author

Matt Walker's research examines the impact of sleep on human health and disease. He got his PhD from the Medical Research Council in London, UK, and subsequently became a Professor of Psychiatry at Harvard Medical School. He's currently a Professor of Neuroscience and Psychology at the University of California, Berkeley, and Director of the Center for Human Sleep Science.

Walker has received funding awards from the National Science Foundation and the National Institutes of Health, and he's a Kavli Fellow of the National Academy of Sciences.

From this point, it may only get worse.
Not only will I tell you about the wonderfully good things
that happen when you get sleep,
but the alarmingly bad things that happen when you don't get enough,
both for your brain and for your body.

Let me start with the brain
and the functions of learning and memory,
because what we've discovered over the past 10 or so years
is that you need sleep after learning
to essentially hit the save button on those new memories
so that you don't forget.
But recently, we discovered that you also need sleep before learning
to actually prepare your brain,
almost like a dry sponge
ready to initially soak up new information.
And without sleep, the memory circuits of the brain
essentially become waterlogged, as it were,
and you can't absorb new memories.

footnote
So let me show you the data.
Here in this study, we decided to test the hypothesis
that pulling the all-nighter was a good idea.

So we took a group of individuals
and we assigned them to one of two experimental groups:
a sleep group and a sleep deprivation group.
Now the sleep group, they're going to get a full eight hours of slumber,
but the deprivation group, we're going to keep them awake
in the laboratory, under full supervision.
There's no naps or caffeine, by the way, so it's miserable for everyone involved.
And then the next day,
we're going to place those participants inside an MRI scanner
and we're going to have them try and learn a whole list of new facts
as we're taking snapshots of brain activity.
And then we're going to test them
to see how effective that learning has been.
And that's what you're looking at here on the vertical axis.
And when you put those two groups head to head,
what you find is a quite significant, 40-percent deficit
in the ability of the brain to make new memories without sleep.

I think this should be concerning,
considering what we know is happening to sleep
in our education populations right now.
In fact, to put that in context,
it would be the difference in a child acing an exam
versus failing it miserably -- 40 percent.
And we've gone on to discover what goes wrong within your brain
to produce these types of learning disabilities.
And there's a structure that sits
on the left and the right side of your brain, called the hippocampus.
And you can think of the hippocampus
almost like the informational inbox of your brain.
It's very good at receiving new memory files
and then holding on to them.
And when you look at this structure
in those people who'd had a full night of sleep,
we saw lots of healthy learning-related activity.
Yet in those people who were sleep-deprived,
we actually couldn't find any significant signal whatsoever.
So it's almost as though sleep deprivation had shut down your memory inbox,
and any new incoming files -- they were just being bounced.
You couldn't effectively commit new experiences to memory.

So that's the bad that can happen if I were to take sleep away from you,
but let me just come back to that control group for a second.
Do you remember those folks that got a full eight hours of sleep?
Well, we can ask a very different question:
What is it about the physiological quality of your sleep
when you do get it
that restores and enhances your memory and learning ability
each and every day?
And by placing electrodes all over the head,
what we've discovered is that there are big, powerful brainwaves
that happen during the very deepest stages of sleep
that have riding on top of them
these spectacular bursts of electrical activity
that we call sleep spindles.
And it's the combined quality of these deep-sleep brainwaves
that acts like a file-transfer mechanism at night,
shifting memories from a short-term vulnerable reservoir
to a more permanent long-term storage site within the brain,
and therefore protecting them, making them safe.
And it is important that we understand
what during sleep actually transacts these memory benefits,
because there are real medical and societal implications.

And let me just tell you about one area
that we've moved this work out into, clinically,
which is the context of aging and dementia.
Because it's of course no secret that, as we get older,
our learning and memory abilities begin to fade and decline.
But what we've also discovered
is that a physiological signature of aging is that your sleep gets worse,
especially that deep quality of sleep that I was just discussing.
And only last year, we finally published evidence
that these two things, they're not simply co-occurring,
they are significantly interrelated.
And it suggests that the disruption of deep sleep
is an underappreciated factor
that is contributing to cognitive decline or memory decline
in aging, and most recently we've discovered,
in Alzheimer's disease as well.

Now, I know this is remarkably depressing news.
It's in the mail. It's coming at you.
But there's a potential silver lining here.

Unlike many of the other factors that we know are associated with aging,
for example changes in the physical structure of the brain,
that's fiendishly difficult to treat.
But that sleep is a missing piece in the explanatory puzzle
of aging and Alzheimer's is exciting
because we may be able to do something about it.
And one way that we are approaching this at my sleep center
is not by using sleeping pills, by the way.
Unfortunately, they are blunt instruments that do not produce naturalistic sleep.
Instead, we're actually developing a method based on this.
It's called direct current brain stimulation.
You insert a small amount of voltage into the brain,
so small you typically don't feel it,
but it has a measurable impact.
Now if you apply this stimulation during sleep in young, healthy adults,
as if you're sort of singing in time with those deep-sleep brainwaves,
not only can you amplify the size of those deep-sleep brainwaves,
but in doing so, we can almost double the amount of memory benefit
that you get from sleep.
The question now is whether we can translate
this same affordable, potentially portable piece of technology
into older adults and those with dementia.
Can we restore back some healthy quality of deep sleep,
and in doing so, can we salvage aspects of their learning
and memory function?
That is my real hope now.
That's one of our moon-shot goals, as it were.

footnote
So that's an example of sleep for your brain,
but sleep is just as essential for your body.
We've already spoken about sleep loss and your reproductive system.
Or I could tell you about sleep loss and your cardiovascular system,
and that all it takes is one hour.
Because there is a global experiment performed on 1.6 billion people
across 70 countries twice a year,
and it's called daylight saving time.
Now, in the spring, when we lose one hour of sleep,
we see a subsequent 24-percent increase in heart attacks that following day.
In the autumn, when we gain an hour of sleep,
we see a 21-percent reduction in heart attacks.

Isn't that incredible?
And you see exactly the same profile for car crashes, road traffic accidents, even suicide rates.

But as a deeper dive, I want to focus on this:
sleep loss and your immune system.
And here, I'll introduce these delightful blue elements in the image.
They are called natural killer cells,
and you can think of natural killer cells almost like the secret service agents of your immune system.
They are very good at identifying dangerous, unwanted elements and eliminating them.
In fact, what they're doing here is destroying a cancerous tumor mass.
So what you wish for is a virile set of these immune assassins at all times,
and tragically, that's what you don't have if you're not sleeping enough.

footnote
So here in this experiment,
you're not going to have your sleep deprived for an entire night,
you're simply going to have your sleep restricted to four hours for one single night,
and then we're going to look to see what's the percent reduction in immune cell activity that you suffer.
And it's not small -- it's not 10 percent,
it's not 20 percent.
There was a 70-percent drop in natural killer cell activity.
That's a concerning state of immune deficiency,
and you can perhaps understand why we're now finding significant links between short sleep duration and your risk for the development of numerous forms of cancer.
Currently, that list includes cancer of the bowel,
cancer of the prostate and cancer of the breast.
In fact, the link between a lack of sleep and cancer is now so strong that the World Health Organization has classified any form of nighttime shift work as a probable carcinogen,
because of a disruption of your sleep-wake rhythms.

So you may have heard of that old maxim
that you can sleep when you're dead.
Well, I'm being quite serious now --
it is mortally unwise advice.

We know this from epidemiological studies across millions of individuals.
There's a simple truth:
the shorter your sleep, the shorter your life.
Short sleep predicts all-cause mortality.

And if increasing your risk for the development of cancer
or even Alzheimer's disease
were not sufficiently disquieting,
we have since discovered that a lack of sleep will even erode
the very fabric of biological life itself,
your DNA genetic code.
So here in this study, they took a group of healthy adults
and they limited them to six hours of sleep a night
for one week,
and then they measured the change in their gene activity profile
relative to when those same individuals
were getting a full eight hours of sleep a night.
And there were two critical findings.
First, a sizable and significant 711 genes
were distorted in their activity,
caused by a lack of sleep.
The second result was that about half of those genes
were actually increased in their activity.
The other half were decreased.

Now those genes that were switched off by a lack of sleep
were genes associated with your immune system,
so once again, you can see that immune deficiency.
In contrast, those genes that were actually upregulated
or increased by way of a lack of sleep,
were genes associated with the promotion of tumors,
genes associated with long-term chronic inflammation within the body,
and genes associated with stress,
and, as a consequence, cardiovascular disease.
There is simply no aspect of your wellness
that can retreat at the sign of sleep deprivation
and get away unscathed.
It's rather like a broken water pipe in your home.
Sleep loss will leak down into every nook and cranny
of your physiology,
even tampering with the very DNA nucleic alphabet
that spells out your daily health narrative.

And at this point, you may be thinking,
"Oh my goodness, how do I start to get better sleep?
What are you tips for good sleep?"
Well, beyond avoiding the damaging and harmful impact
of alcohol and caffeine on sleep,
and if you're struggling with sleep at night,
avoiding naps during the day,
I have two pieces of advice for you.

The first is regularity.
Go to bed at the same time, wake up at the same time,
no matter whether it's the weekday or the weekend.
Regularity is king,
and it will anchor your sleep
and improve the quantity and the quality of that sleep.
The second is keep it cool.
Your body needs to drop its core temperature
by about two to three degrees Fahrenheit to initiate sleep
and then to stay asleep,
and it's the reason you will always find it easier
to fall asleep in a room that's too cold
than too hot.
So aim for a bedroom temperature of around 65 degrees,
or about 18 degrees Celsius.
That's going to be optimal for the sleep of most people.

And then finally, in taking a step back, then,
what is the mission-critical statement here?
Well, I think it may be this:
sleep, unfortunately, is not an optional lifestyle luxury.
Sleep is a nonnegotiable biological necessity.
It is your life-support system,
and it is Mother Nature's best effort yet at immortality.
And the decimation of sleep throughout industrialized nations
is having a catastrophic impact on our health, our wellness,
even the safety and the education of our children.
It's a silent sleep loss epidemic,
and it's fast becoming one of the greatest public health challenges
that we face in the 21st century.

I believe it is now time for us to reclaim our right
to a full night of sleep,
and without embarrassment

or that unfortunate stigma of laziness.
And in doing so, we can be reunited with the most powerful elixir of life, the Swiss Army knife of health, as it were.

Footnotes

"Men who sleep five hours a night have significantly smaller testicles than those who sleep seven hours or more."
This observation comes from Zhang, W et al. (2018). "Sleep Duration Is Associated With Testis Size in Healthy Young Men" *Journal of Clinical Sleep Medicine* 14(10): 1757-764.

Note
"And then the next day, we're going to place those participants inside an MRI scanner and we're going to have them try and learn a whole list of new facts as we're taking snapshots of brain activity. And then we're going to test them to see how effective that learning has been. And that's what you're looking at here on the vertical axis. And when you put those two groups head to head, what you find is a quite significant, 40-percent deficit in the ability of the brain to make new memories without sleep."

Clarification: These findings come from unpublished research cited in 2006, which highlighted a 40% reduction in memory retention for sleep-deprived subjects. For more on this 40% deficit, see Walker, M and Stickgold, R (2006). "Sleep, Memory, and Plasticity." *Annual Review of Psychology* 57(1): 139-166.

See also the following study on memory performance in sleep-deprived subjects, which highlights a 19% deficit for that group relative to subjects who experienced a normal night of sleep: Yoo, S., Hu, P. T., Gujar, N., Jolesz, F. A., & Walker, M. P. (2007). "A deficit in the ability to form new human memories without sleep." *Nature Neuroscience* 10(3): 385-392.
Note
"Now, in the spring, when we lose one hour of sleep, we see a subsequent 24-percent increase in heart attacks that following day. In the autumn, when we gain an hour of sleep, we see a 21-percent reduction in heart attacks."

These findings were specific to non-federal hospital admissions in the state of Michigan. For more, see Sandhu, A., Seth, M., Gurm H.S (2014) "Daylight savings time and myocardial infarction." *Open Heart* 1:e000019.

Note

"So here in this experiment, you're not going to have your sleep deprived for an entire night, you're simply going to have your sleep restricted to four hours for one single night, and then we're going to look to see what's the percent reduction in immune cell activity that you suffer. And it's not small — it's not 10 percent, it's not 20 percent. There was a 70-percent drop in natural killer cell activity."

The publication date of this study was 1994, and it looked at the impact of sleep restriction on natural killer cell activity in medically health adults. For more, see Irwin, M. et al. (1994). "Partial sleep deprivation reduces natural killer cell activity in humans." *Psychosomatic Medicine* 56(6): 493-498.