نتائج دراسات بشأن الإجهاد الحراري

عرض تقدّمه

الدكتورة فيديا فينوغوبال

استاذة ومديرة قطريّة لدى

المعهد الوطني لأبحاث الصحة والرعاية مركز الأمراض غير المعدية والتغير البيئي

نيابةً عن

فريق الدراسات حول الاحترار في الهند

قسم هندسة الصحة البيئية.

كلية الصحة العامة،

معهد سري راماشاندرا للتعليم العالي والبحث

نبذة عن المضمون.. .....

- من نحن؟؟
- سيناريو حول الاحترار في العالم والهند
- الحاجة إلى دراسات حول الاحترار في الهند
- نتائج الأبحاث بشان الاحترار
  - الأدلّة
- النتائج الرئيسية
- التعاون والخطوات المستقبلية

يعترف بنا كلّ من...

مجلس الهند للبحوث الطبيّة، الهند

مركز البحوث المتقدّمة حول جودة الهواء والمناخ والصحة

2016

SRIHER

2008

منظمة العمل الدولية

المعهد الوطني لأبحاث الصحة والرعاية، المملكة المتحدة

مركز الأمراض غير المعدية والتغير البيئي

2022

2007- حتى تاريخه

منظمة الصحّة العالميّة

مركز التعاون حول الصحّة المهنيّة والبيئيّة

NIHR | National Institute for Health Research

المنح البحثية، النظافة الصناعية والأكاديميين

المناصب الأساسيّة

- **عضو منتخب في مجلس الإدارة،** CENCAM.
- **عضو استشاري علمي في** شبكة La isla .
- عضو **اللجنة التوجيهية** DEGREE & NIHR.
- **عضو خبير في التغيّر المناخي، حكومة الهند**

10
استاذة الدكتوراه
إرشاد

110
استشاري
في قطاع الصناعة

12
دراسات عليا
دورات وإرشادات

5000
WBGT
قياسات

$1,25,573
إجمالي مبلغ المنحة المتولدة عن مشاريع أبحاث الصحة والسلامة المهنيّتين

موجات الحر في الهند .. ...

- العد التنازلي لانسيت للصحة وتغير المناخ :تفيد زيادة **بنسبة 50٪** في الوفيات الناتجة عن الاحترار في الهند بأنّ الصحة تحت رحمة الوقود الأحفوري.

- بين عامي 2000و 2004، توفي ما معدله 20000شخص سنويًا ممن تزيد أعمارهم عن 65عامًا لأسباب تتعلّق بالاحترار؛ ارتفع هذا الرقم إلى / 31000سنويًا بين عامي 2017و 2021 .

-صحيفة تايمز أوف إنديا

حالة الاحترار في الهند...

In Maharashtra heatstroke deaths, the critical factor of humidity

AMITABH SINHA
NEW DELHI, APRIL 17

THIRTEEN PEOPLE died from an apparent heatstroke while attending a government award function in an open space in Navi Mumbai Sunday. This is possibly the biggest-ever heatwave-related death toll from a single event in the country, and brings back the spotlight on potential risks from heatwaves, whose intensity and frequency is expected to rise because of climate change.

This year, heatwave conditions developed even in February, an unprecedented occurrence. After a relatively cool March, the summer is expected to be extremely hot, and several parts of the country are likely to experience multiple spells of heatwaves.

Notably, Mumbai, where the deaths took place on Sunday, is not even facing heatwave conditions at present. According to India Meteorological Department (IMD), heatwave conditions are currently prevailing in some areas of Gangetic West Bengal, coastal Andhra Pradesh, and Bihar. In most parts of Mumbai, maximum temperatures on Sunday were in the range of 30-35 degrees Celsius, and conditions are expected to remain this way for the next few days.

The huge crowd that gathered for the event in Navi Mumbai on Sunday. *Deepak Joshi*

Humidity crucial

However, high temperature in itself is not fatal. The combination of high temperature and high humidity, referred to as the wet bulb temperature, is what makes heatwaves deadly. High moisture content in the atmosphere makes it difficult for the sweat to evaporate and bodies to cool down, as a result of which the internal body temperature increases sharply, and is often fatal.

Though the humidity levels at the venue are not clearly known, Anup Kumar Srivastava, a former senior consultant with the National Disaster Management Authority, said there could be several reasons for this unusually high death toll from the event, attended by thousands of people.

"It is possible that many people travelled large distances to come to this event and were exhausted. That makes people more vulnerable to heat strokes. Residents of generally cooler places, like coastal areas, are particularly susceptible to prolonged exposure to heat. People with underlying health conditions are also a high-risk group," said Srivastava, who has worked on devising and monitoring heat action plans in states and districts for several years.

"Also, in such a large gathering, it is difficult to ensure that everyone has immediate access to drinking water or oral rehydration solutions (ORS). These can be lifesavers in such situations. We do not know how quickly the people received medical attention. Timely medical intervention is extremely important," he said.

Norms for political gatherings

Prodded by the NDMA, the Election Commission had, just ahead of the general elections in 2019, circulated a detailed advisory on precautions to be taken to conduct the polls in heatwave-like conditions. Electoral officers were advised to ensure that every polling booth had provisions for drinking water, functional clean toilets, facilities for people to sit, some areas under shade, and essential medical kits.

There are advisories for political parties organising political events or campaign rallies during the election season. Parties are supposed to ensure that water, ORS packets, medical kits, and mobile ambulances are readily available at all such events. These advisories are relevant for Karnataka, which is in the midst of an election campaign. There are no immediate forecasts of heatwave-like conditions in Karnataka right now, but the state is not immune from heatwaves.

HEAT-LINKED DEATHS

Year	Deaths
2010	269
2011	12
2012	729
2013	1,433
2014	548
2015	2,040
2016	1,111
2017	384
2018	25
2019	226
2020	4
2021	4
2022	33

Compiled from Ministry of Earth Sciences, NDMA and Ministry of Health

Fewer heat-related deaths

Monitoring and management of heatwaves has undergone a big improvement in the past few years and that has resulted in a sharp decline in deaths caused by heatwaves. Almost every vulnerable state now has a heat action plan in place, consisting mainly of early warning, provision of water and ORS at public places, and flexible working hours in offices and education institutions. Special arrangements are made for people working outdoors.

In the 10 years between 2010 and 2020, reported heatwave-related deaths in India came down by more than 90 per cent. Heatwave fatalities had peaked in 2015, when more than 2,000 deaths were reported. This was the time when states and district administrations started implementing heat action plans. The death count dropped rapidly in the next few years, and in 2020 and 2021, only four heatwave deaths were reported, according to government figures.

Last year, however, 33 deaths were recorded. Officials say the increase in heatwave-related deaths could also be because of improved monitoring and reporting of incidents. But there is no parallel to the Navi Mumbai incident. In June of 2019, more than 100 heatwave-related deaths were reported from three districts of Bihar alone. Unlike the fatalities in Mumbai on Sunday, these deaths did not come from a single event and were spread over a week.

More intense heatwaves

The summer this year is predicted to be excessively hot because of the end of the strong La Nina phase in equatorial Pacific Ocean, something that has a general cooling effect on the earth's atmosphere. New forecasts suggest that El Nino, which has the opposite impacts of La Nina, is expected to kick in from the May-July period itself, earlier than expected. El Nino also tends to result in suppression of monsoon rainfall over India. A shortfall in rains is already being apprehended, which could exacerbate the effects of a hot summer, even though the India Meteorological Department has predicted a normal monsoon.

Over a longer term, heatwaves are predicted to become more intense, prolonged and frequent because of climate change. Srivastava said the Mumbai incident should be a wake-up call for the authorities.

"Heat related deaths can be prevented easily. Relatively simple measures like access to water, ORS, and shade can prevent hundreds of deaths. But these do not happen on their own. The local administration needs to be vigilant and pro-active. And the implementation needs to be monitored by higher authorities on a daily basis. Karnataka elections can be a good test of our strategy. We were winning this battle just a couple of years ago. There is no reason why we should slide back," Srivastava said.

The Indian EXPRESS Tue, 18 April 2023 https://epaper.indianexpress.com/c/72204864

في شهر أبريل 2023، في حفل توزيع الجوائز في مكانٍ مكشوفٍ **في مومباي**، توفي **13شخصًا من ضربة الشمس ودخل 600إلى المستشفى**. لعلّ هذا العدد هو الأكبر على صعيد الوفيات المرتبطة بموجات الحرّ في البلاد، مما يؤكد على التحدّيات في هذا الصدد.

Mercury touches 39.1°C

Guj reporting rate of heat ailments highest in India

With 82 percent of all cases reported, Guj tops the list among states; over 1,900 of the 2,300 centres upload daily reports on IHIP portal

Brendan.Dabhi
@ahmedabadmirror.in

TWEETS @BrendanMIRROR

A month after the Centre directly began collecting data on heat-related ailments and deaths, Gujarat has emerged as the state with the highest reporting turnout in the country. The data collection began from March 1 under the National Digital System for Heat Health Surveillance. Incidentally, Mercury touched 39.1°Celsius in Ahmedabad on Sunday, the highest in April so far.

Gujarat's public sector health centres have been reporting heat stroke, and other ailments and even sending nil reports daily to the national system. A senior health official said Gujarat's reporting rate was 82% in the first month between March 1 and 31.

JIGNESH VORA

other states or Union Territories (UTs) in India. Apart from Gujarat, the list of best reporting regions include the UT of Dadra and Nagar Haveli which has more than 50% of centres reporting heat-related ailments.

Gujarat has th
in India as over 1,
tres continued to
on the Integrated
Platform (IHIP). T
Integrated Dis
Programme (IDSI
Gujarat's heat
is at least 25% h

Chennai's scorching summers get hotter

Though on an upward trend, meteorologists and experts note that it is not at an alarming level. When coronavirus infections are spreading rapidly, the rising temperature and its health impact should not be forgotten, say doctors

April 11, 2021 01:24 am | Updated 03:56 pm IST

K. LAKSHMI, SERENA JOSEPHINE M.

COMMENTS SHARE READ LATER

كان أبريل أكثر الشهور سخونة في تشيناي، حيث بلغت أقصى درجات الحرارة **41.2درجة مئوية، بزيادة قدرها 7.4درجة عن المعدّل.**

حكومة الهند -المبادرات

على المستوى المركزي

भारत सरकार
स्वास्थ्य एवं परिवार कल्याण विभाग
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
Government of India
Department of Health and Family Welfare
Ministry of Health and Family Welfare

राजेश भूषण, आईएएस
सचिव
RAJESH BHUSHAN, IAS
SECRETARY

D.O.90/NCDC/CEOH&CCH/2020-21/Heatwaveadvisory
30th April 2022

Dear Colleague,

The Seasonal and Monthly Outlook from Indian Meteorological Department (IMD) for March-May 2022 predicts above normal maximum temperatures over many areas of the Country and much higher temperatures in Central, Western and Northern parts of the Country. Temperatures have already touched 46° Celsius at some places and deviation up to 6° Celsius from expected normal temperatures have also been reported.

2. I draw your attention to "**National Action Plan on Heat Related Illnesses**" (released in July 2021), which is available on website of Union Ministry of Health & Family Welfare (mohfw.gov.in) and the website of National Centre for Disease Control (NCDC) (https://ncdc.gov.in/WriteReadData/linkimages/NationActionplanonHeatRelatedIllnesses.pdf). In addition, I also draw your attention to an Advisory issued by this Ministry on 15th March 2022 for Health Facilities on heat re... preparedness, record maintenance and su... another communication from NCDC to all ... escalate heat resilience measures in Health ... this subject was also chaired by Member Sec... all Principal Secretaries of Revenue Depart...

3. I would request you to disseminate th... Plan on Heat Related Illnesses" to all Distri... heat wave. From 1st March 2022, daily su... been initiated under Integrated Disease Surv... and Districts. Please ensure that these daily surveillance reports are shared with NCDC. The daily heat alerts which are being shared by IMD as well as NCDC with States indicate forecast of heat wave for next 3-4 days and may be disseminated promptly at District/Health Facility level.

4. Health Deptt. of the State must continue efforts on sensitization and capacity building of medical officers, health staff, grass-root level workers on heat illness, its early recognition and management. Health Facility preparedness must be reviewed for availability of adequate quantities of essential medicines, I.V. fluids, ice packs, ORS and all necessary equipment. Availability of sufficient drinking water at all Health Facilities and continued functioning of cooling appliances in critical areas must be ensured.

contd..2/-

Room No. 156, A-Wing, Nirman Bhawan, New Delhi-110 011
Tele : (O) 011-23061863, 23063221, Fax : 011-23061252, E-mail : secyhfw@nic.in

نشر خطة العمل الوطنية حول الاحترار

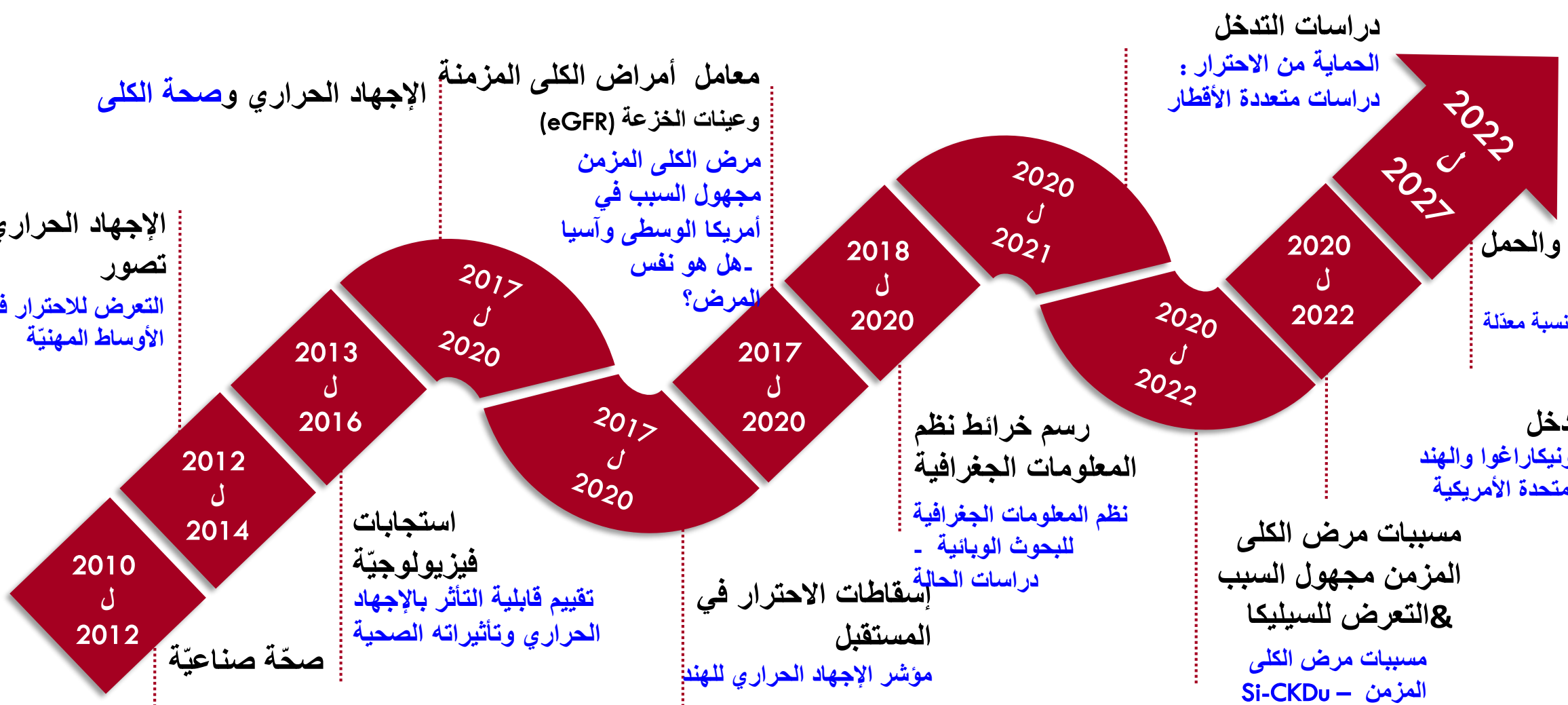
على صعيد الولاية

التثقيف الصحي العام /تعزيز الصحة في ولاية تاميل نادو

لا تلحظ خطّة العمل الوطنيّة حول الاحترار السكان العاملين سوى على نطاقٍ ضيّقٍ

عربات مياه الشرب المتنقلة متمركزة في مؤسسة بلدية أحمد آباد

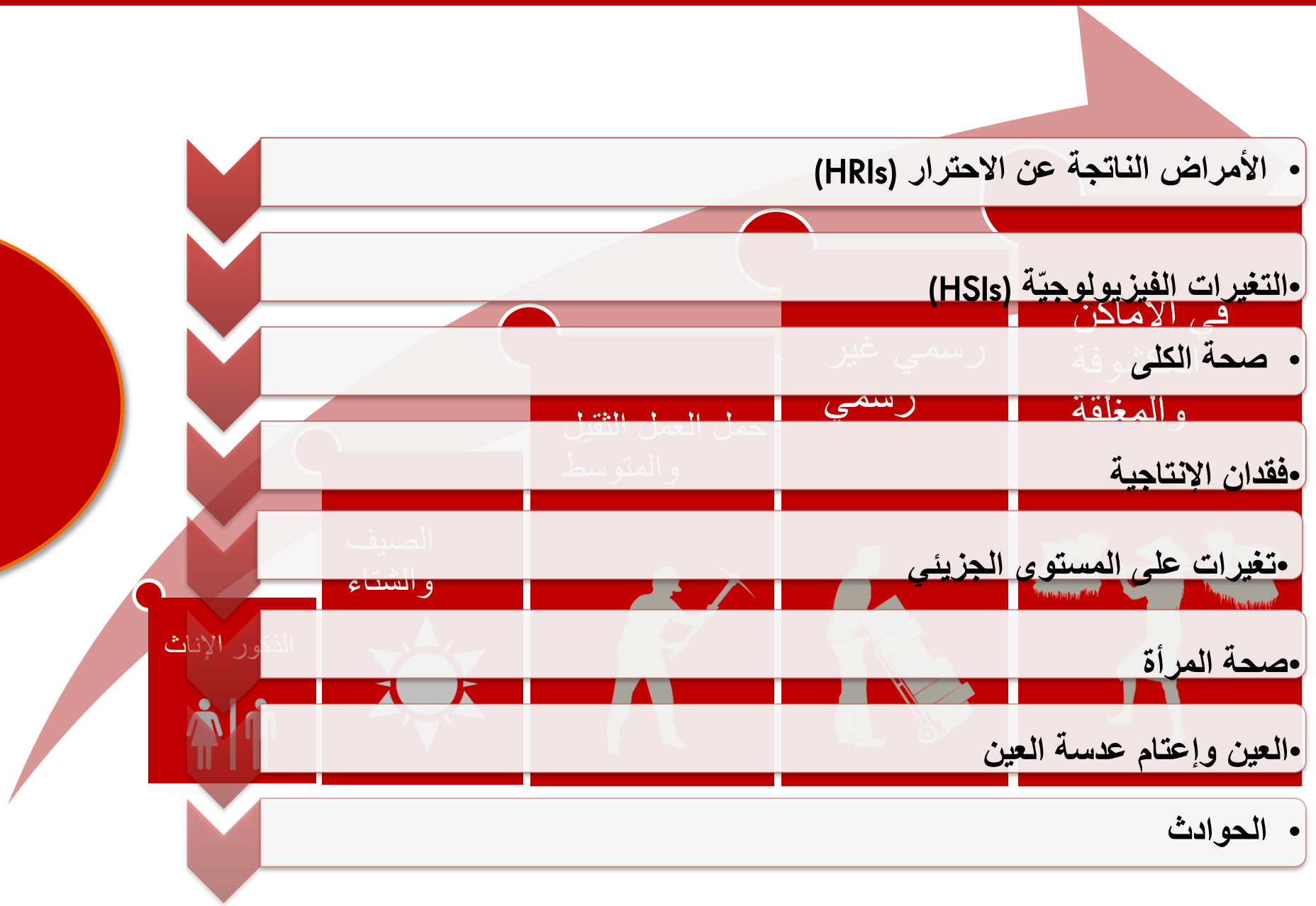
طوّرنا العمل في الأبحاث المتصّلة بالاحترار...



...نطاق أبحاث الاحترار وعمقها

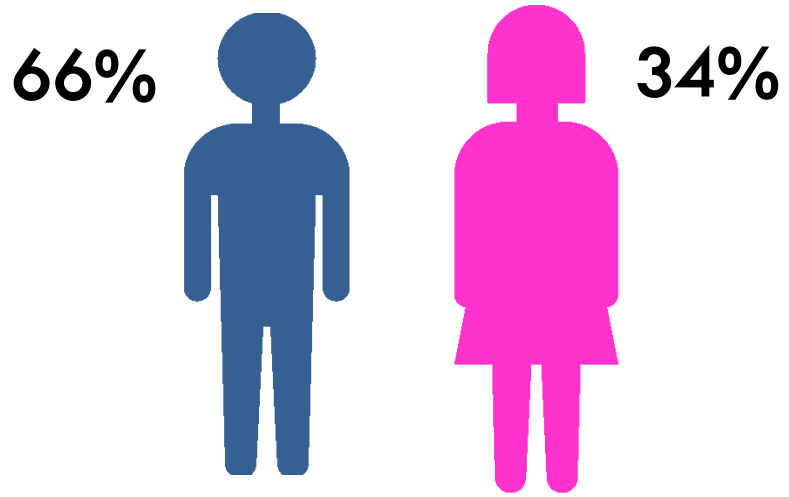
حرارة
&
صحة مهنية

- الأمراض الناتجة عن الاحترار (HRIs)
- التغيرات الفيزيولوجيّة (HSIs)
- صحة الكلى
- فقدان الإنتاجية
- تغيرات على المستوى الجزيئي
- صحة المرأة
- العين وإعتام عدسة العين
- الحوادث

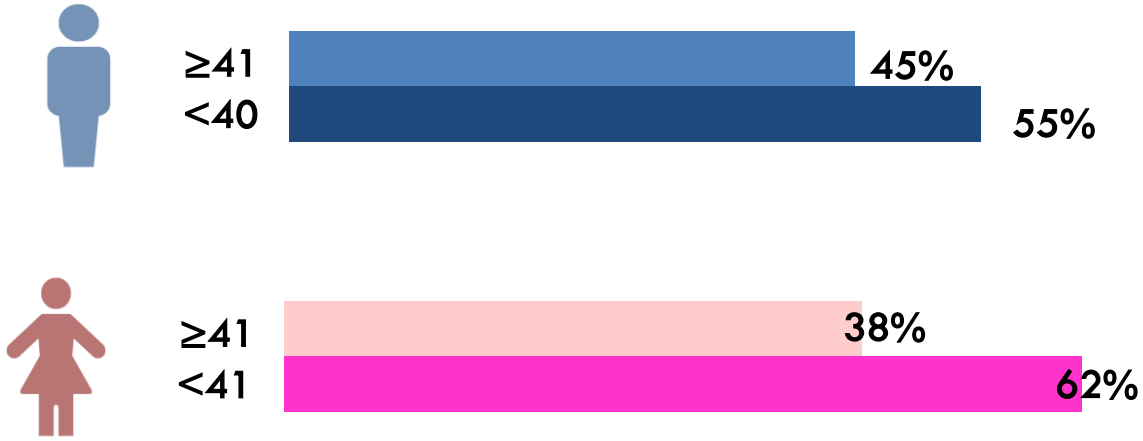


الجوانب الديمغرافيّة (N ~ 4000)

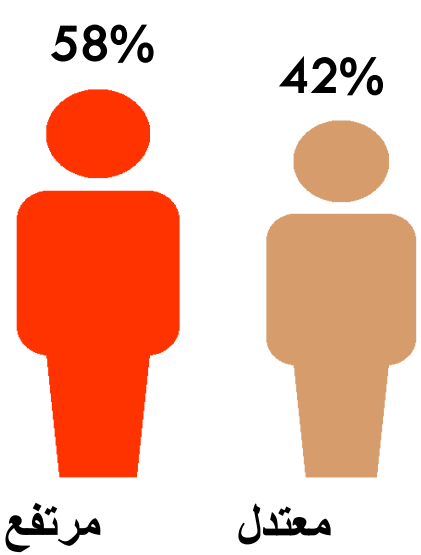
توزيع الجنس والعمر

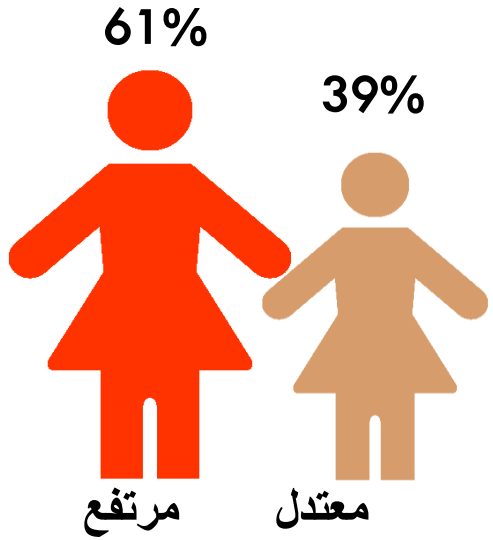


السنّ



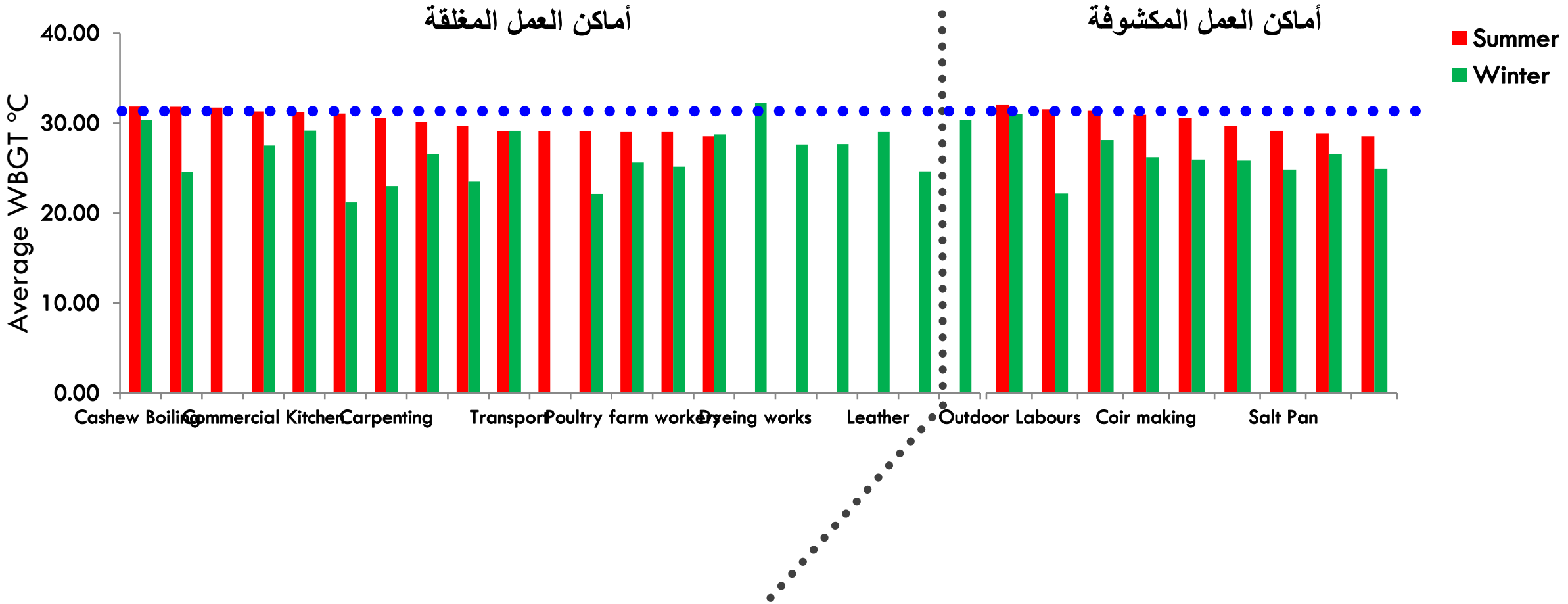
سنوات من التعرض





تعرض درجة حرارة البصيلة الرطبة الكروية في قطاعات الدراسة

31 مهنة



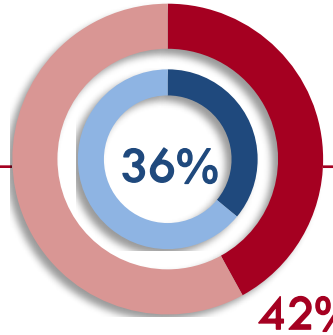
تبليغ ذاتي وتغيير فيزيولوجي

توزيع مواضيع الدراسة الإجماليّة بين القطاعات

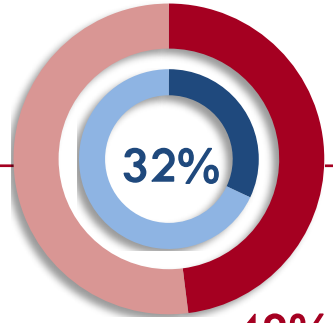
أماكن مكشوفة 2233

أماكن مغلقة 1754

بمقياس التغيير الفيزيولوجي

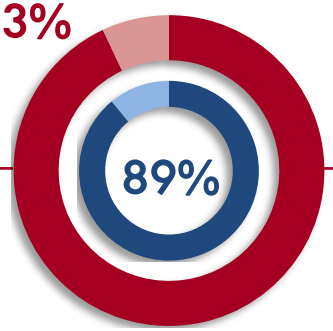


مؤشر الإجهاد الحراري

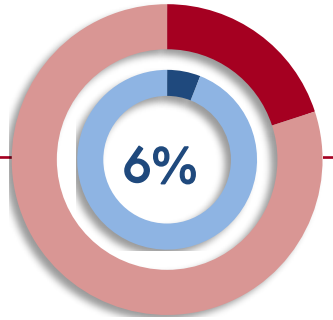


معدل eGFR ≤89 مل/دقيقة/1.73 م²

تبليغ ذاتي



الأمراض الناتجة عن الاحترار

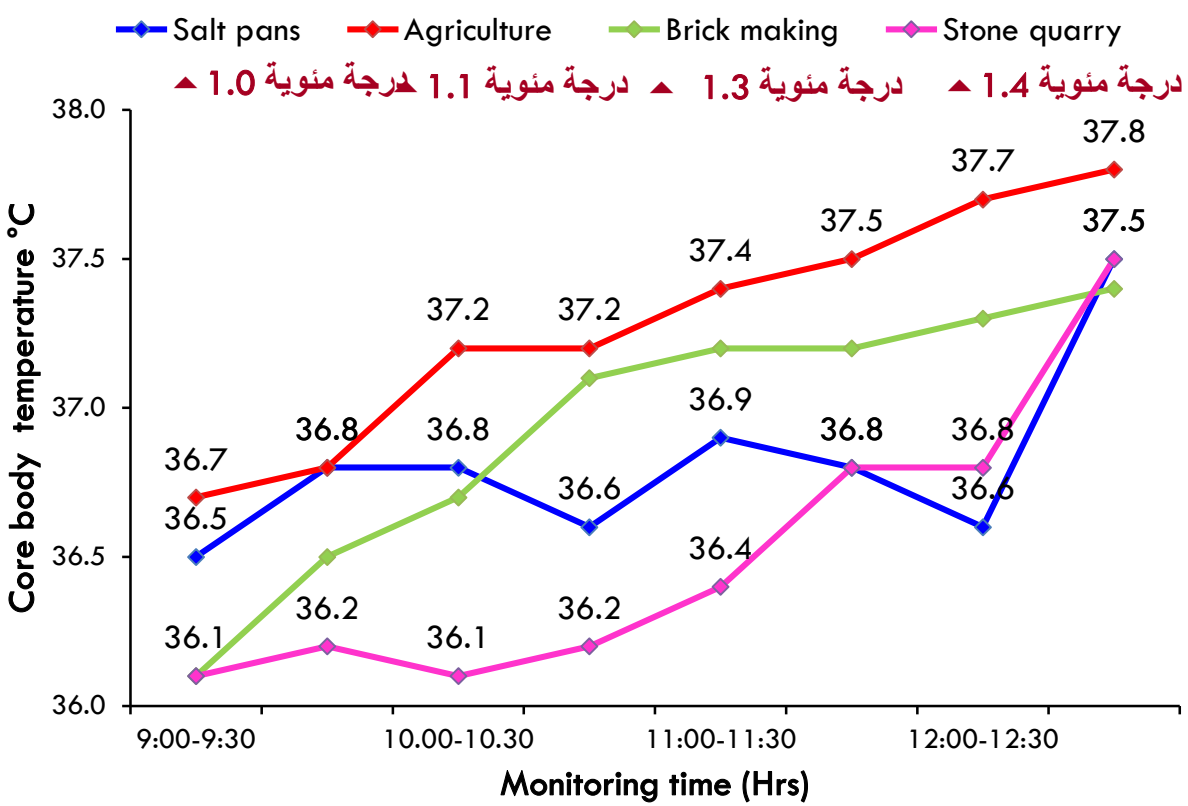


فقدان الإنتاجية

التغييرات المتقاطعة في مؤشرات الإجهاد الحراري -العمال في الأماكن المكشوفة

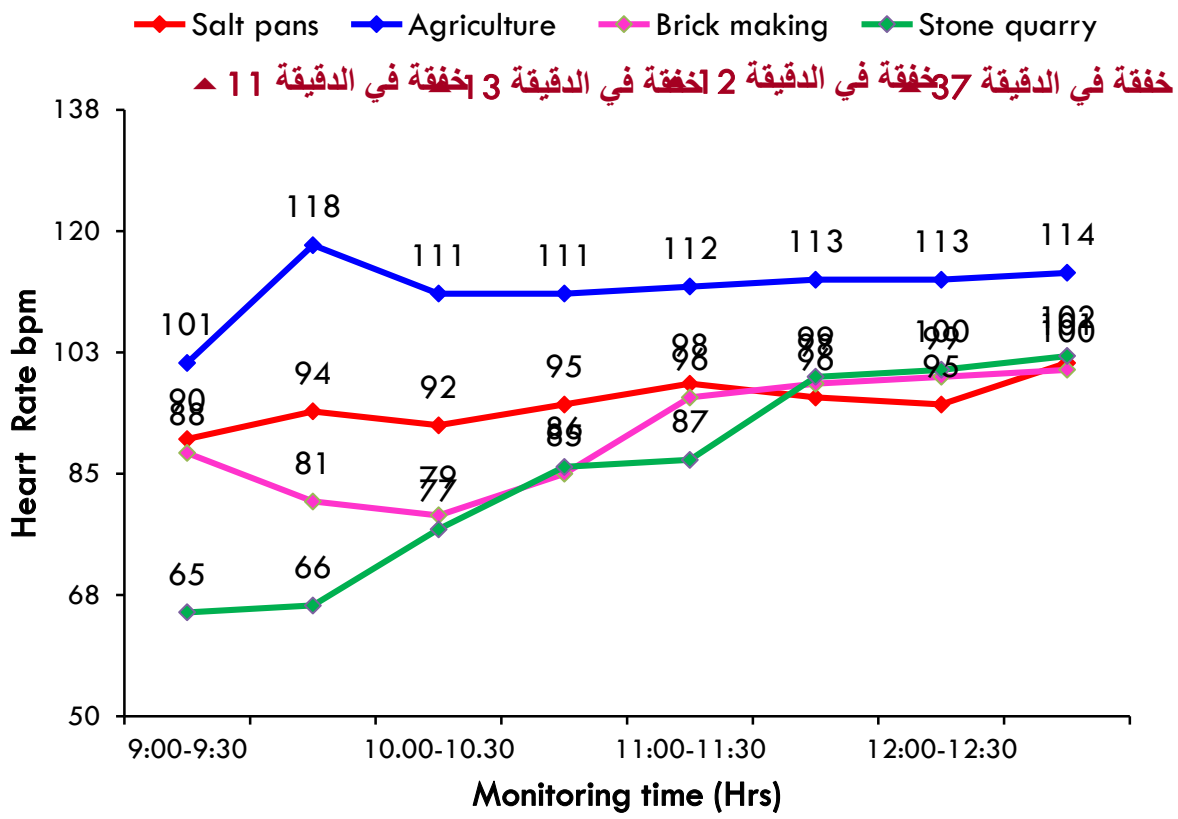
درجة حرارة الجسم الأساسية

فرق 1 1: ≥CBT٪



معدل ضربات القلب

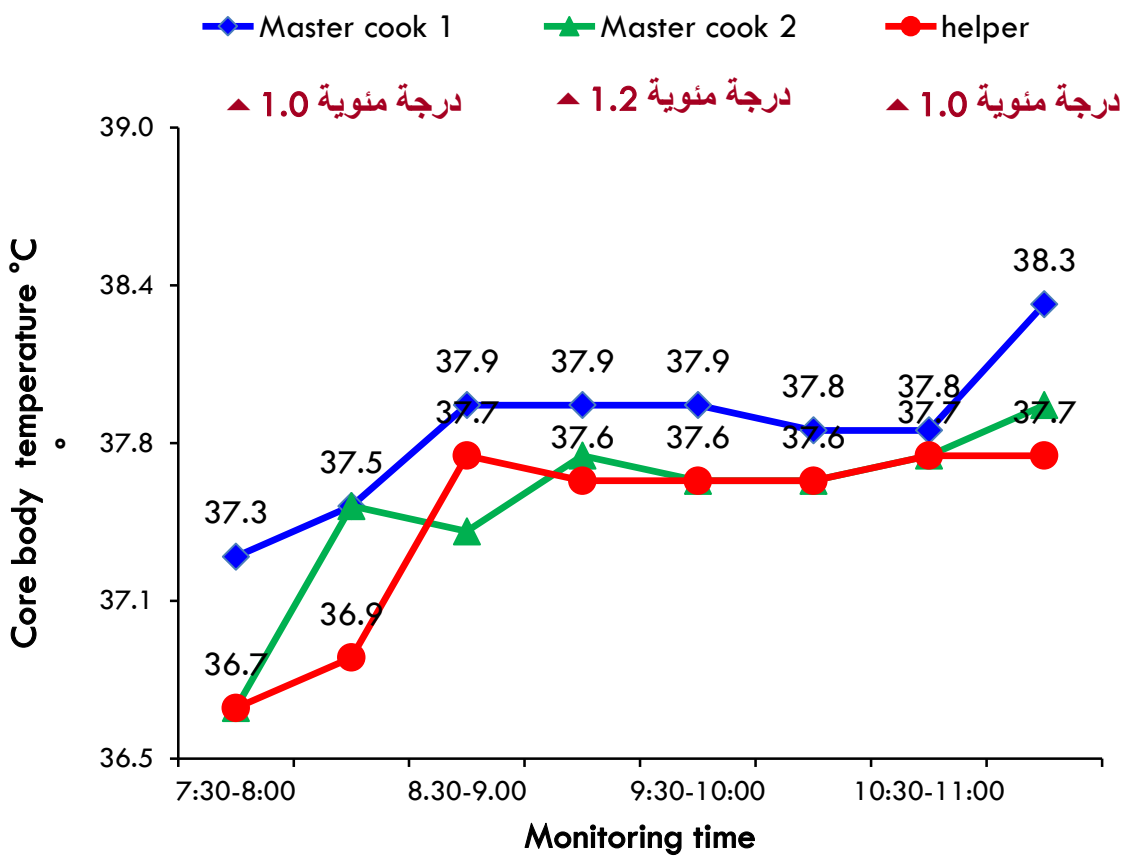
آخر معدل ضربات القلب 100 ≥خفقة في الدقيقة 10 :٪



اتجاه تغيّر درجة حرارة الجسم الأساسيّة ومعدّل ضربات القلب ـ العمّال في الأماكن المغلقة)مطبخ تجاري(

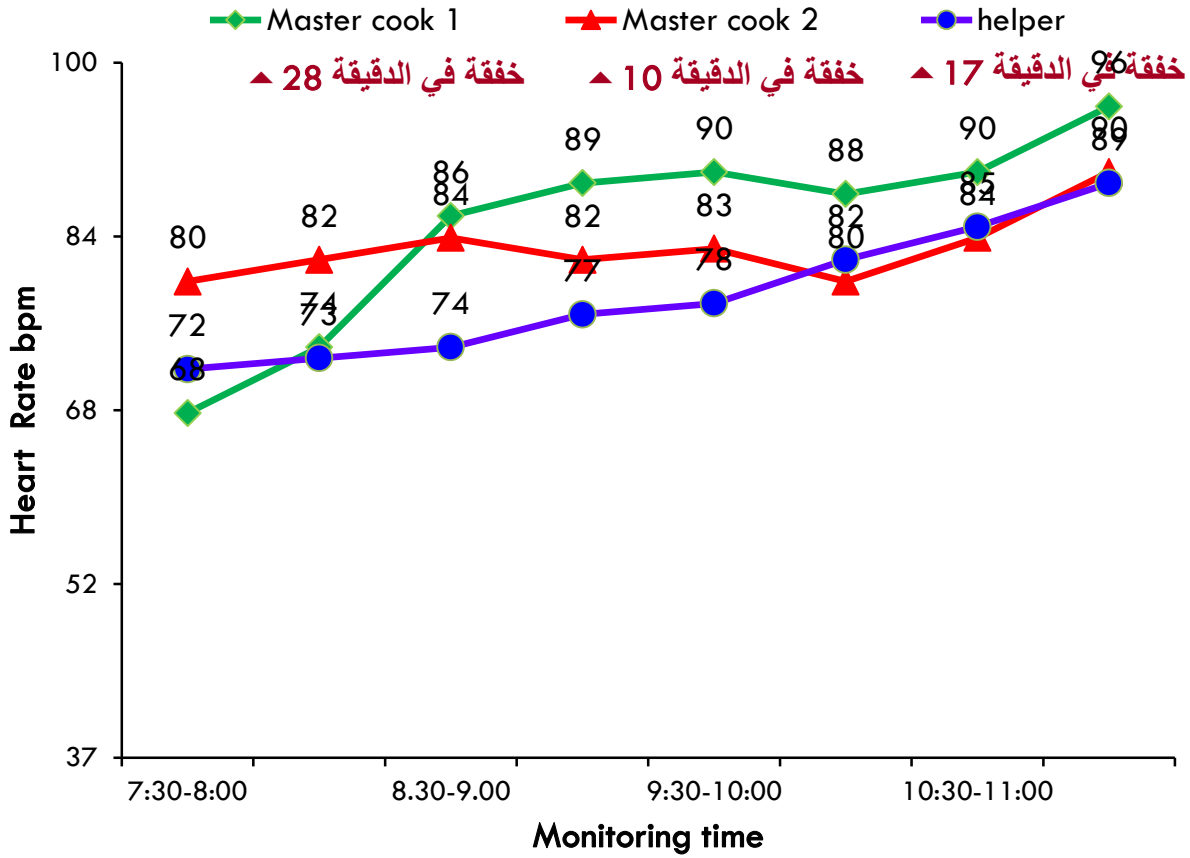
درجة حرارة الجسم الأساسية

فرق 10) 30 :1≥ CBT٪)



معدل ضربات القلب

الفرق في معدل ضربات القلب 10 خفقة في الدقيقة 16 :٪

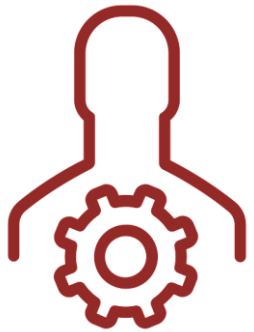


مجموعات العمال المعرضين للخطر .....

متغيرات الدراسة	أماكن مكشوفة مقابل أماكن مغلقة (المرجع)	مرتفع مقابل معتدل (المرجع)	غير رسمي مقابل رسمي (المرجع)	صيف مقابل شتاء (المرجع)	ذكر مقابل أنثى (المرجع)
	% نسبة معدّلة	% نسبة معدّلة	% نسبة معدّلة	% نسبة معدّلة	% نسبة معدّلة
مؤشر الإجهاد الحراري (أي واحد)	71مقابل 29 1.3; (1.1- 1.5)	70مقابل 30 1.2; (1.0 – 1.4)	68مقابل 32 0.7; (0.6 – 0.8)	42مقابل 29 1.5 (1.1-1.5)	67مقابل 33 1.4 (1.1-1.6)
صحة الكلى eGFR ≤89 مل /دقيقة 1.73 / متر مربع	86مقابل 14 2.3; (1.7 - 3.0)	70مقابل 30 1.4; (1.1 – 1.8)	85مقابل 15 0.4; (0.3 - 0.6)	63مقابل 37 2.1; (1.6 - 2.7)	64مقابل 35 3.9; (3.1 – 4.8)
فقدان الإنتاجية	66مقابل 34 1.4; (1.1 - 1.7)	72مقابل 28 1.8; (1.5 - 2.2)	66مقابل 34 1.8; (1.5 - 2.2)	67مقابل 37 1.2; (1.0 - 1.5)	59مقابل 41 غير متوفر

ملحوظة :AOR نسبة معدّلة بحسب سنوات التدخين واستهلاك الكحول والتعرض

عواقب التعرض للحرارة....
العدد (4000 ~)



فقدان الإنتاجية

نسبة معدّلة* 1.4 :

95 ٪CI: 1.1 - 1.7

صحة الكلى

نسبة معدّلة* 2.3:

95 ٪CI: 1.7 - 3.0

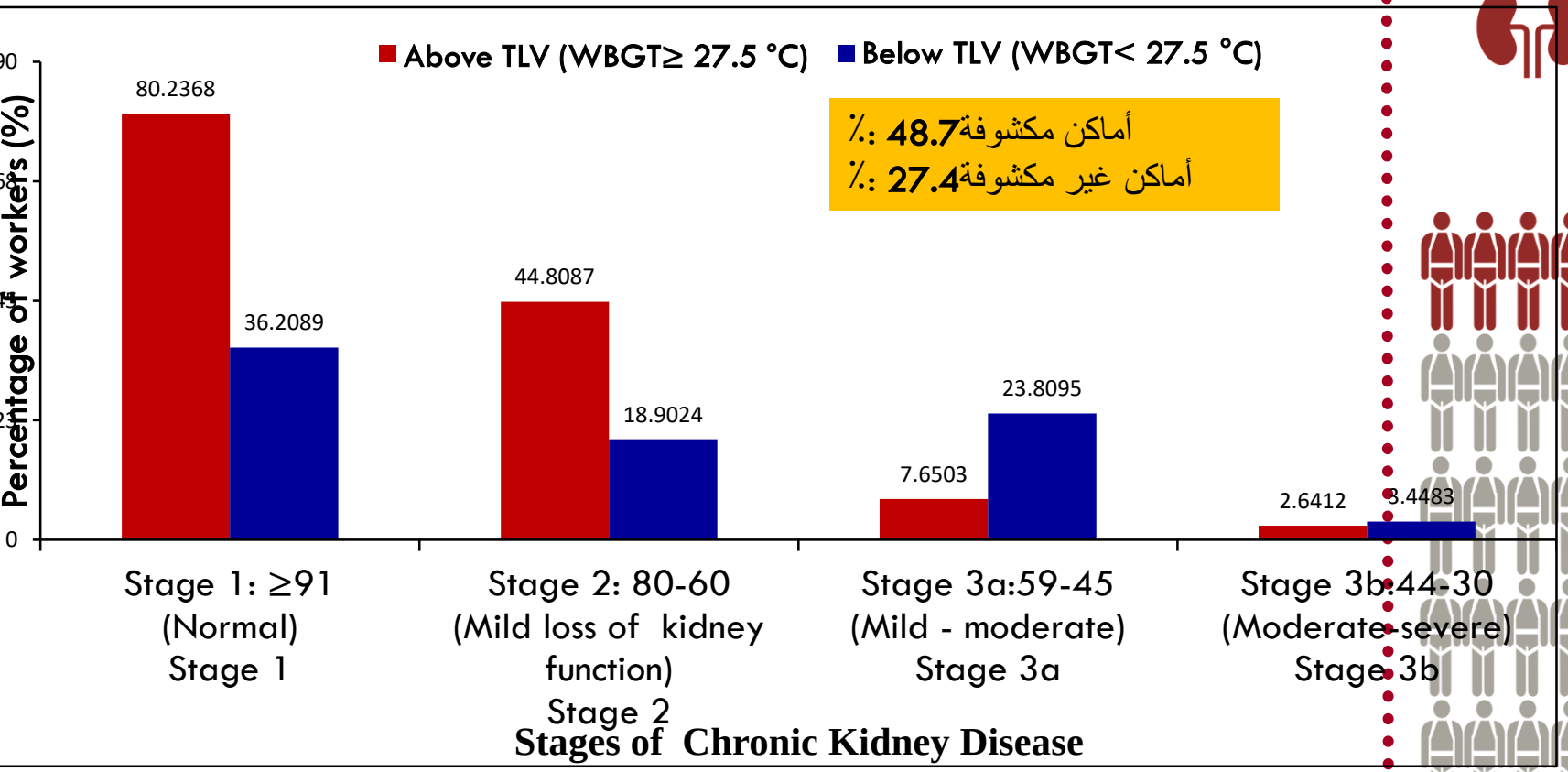
أعراض مؤشّر الإجهاد الحراري و الأمراض الناتجة عن الاحترار

نسبة معدّلة* 1.3 :

95 ٪CI: 1.1 - 1.5

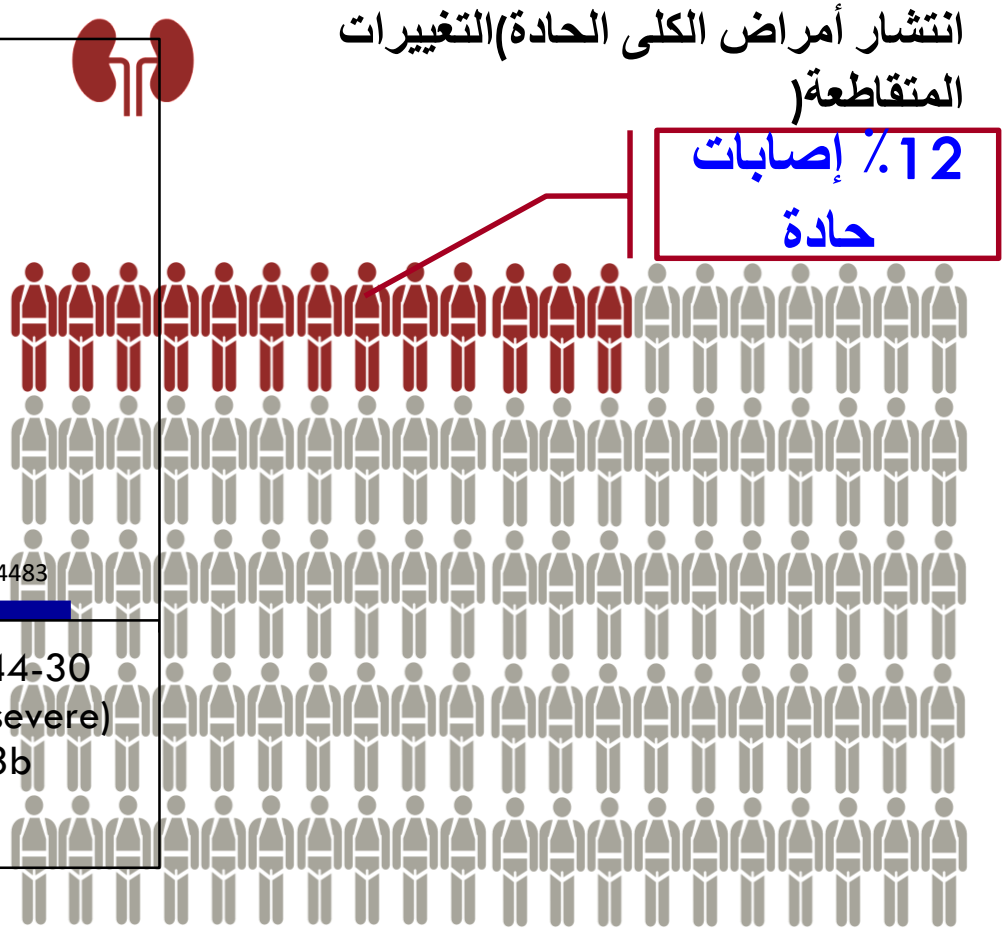
الاحترار وصحة الكلى (العدد (1550 ~ (eGFR)

الأمراض المزمنة



الأمراض الحادة

انتشار أمراض الكلى الحادة)التغييرات المتقاطعة(



الاحترار وحصى الكلى في أماكن العمل المغلقة

340عاملاً في صناعة الصلب

تعرّض 91عاملا في صناعة الصلب إلى الموجات فوق الصوتية على الكلى

التشخيص السريري والإحالة لدى طبيب صحة مهنية مؤهل.

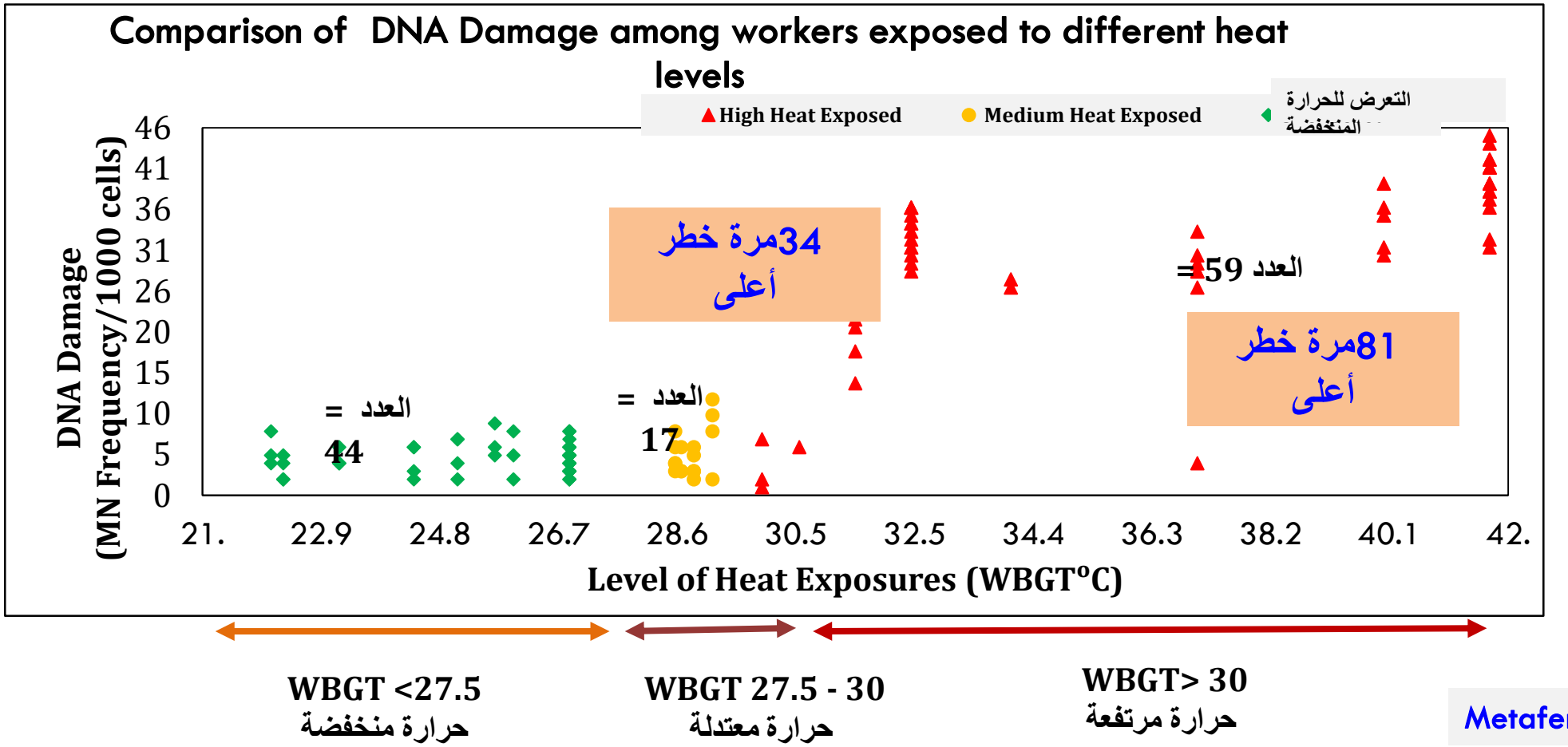
33%

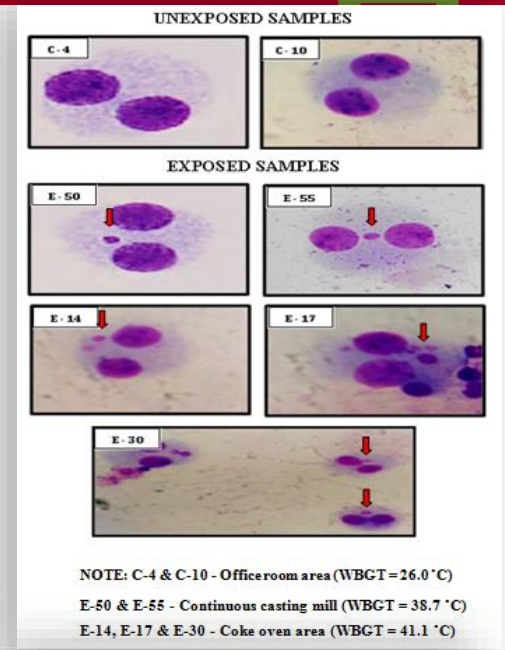
30أصيبوا بتشوهات كلوية هيكلية)الكلى الكيسية، حصوات الكلى /مجرى البول، تضييق مجرى البول(

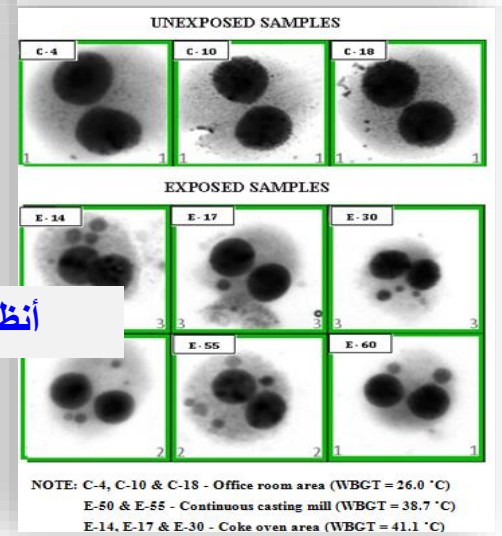
من بين العمّال الثلاثين، جرى تشخيص 25عاملاً أُصيبوا بحصى الكلى . كان العمّال من المناطق الساخنة .

9٪ انتشار حصى الكلى

تأثير الاحترار على المستوى الجزيئي ..







أنظمة Metafer

ملحوظة: *AOR: ° نسبة معدّلة بحسب سنوات التدخين واستهلاك الكحول والتعرض؛ N: تلف الحمض النووي*

الاحترار وصحة المرأة .. ...

نتائج سلبية على الحمل)نسبة معدّلة(

- جميع النتائج السلبيّة على الحمل)الإجهاض، ولادة مبكرة، ولادة الطفل ميتًا، تأخر النمو داخل الرحم، عيب خلقي(
- النتيجة السلبية عند الولادة :ولادة مبكرة، وزن منخفض عند الولادة، ولادة الطفل ميتًا، تأخر النمو داخل الرحم، عيب خلقي
- الإجهاض أو الإجهاض التلقائي

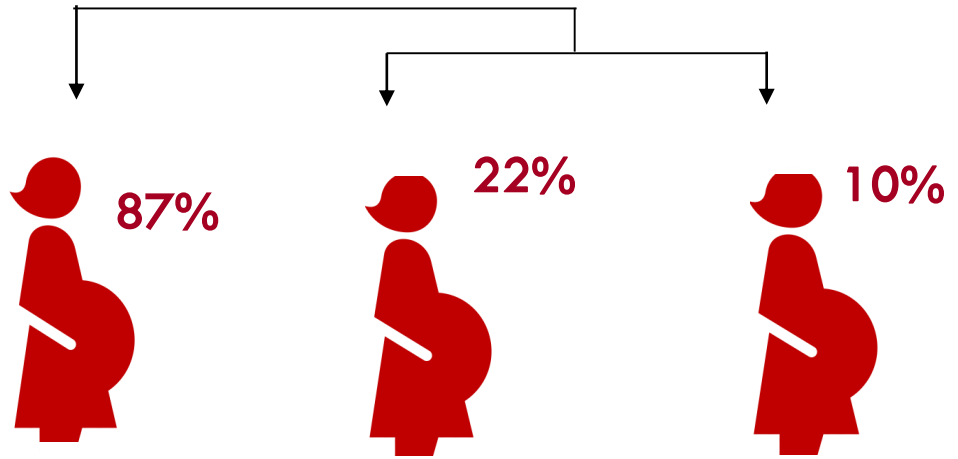
تأثير الاحترار في الحمل

منطقة * AOR: 3.5
95 ٪CI: 1.7 - 6.9

32%

من بين الأمهات الحوامل وعددهنّ 250
تعرّضت 39امرأة لنتائج سلبيّة.

3
فصول



الإجهاض
اجهاض عفوى
نسبة معدّلة * 3.8
95 ٪CI: 1.1 - 13.0

10%

نتائج سلبية عند الولادة
نسبة معدّلة * 2.7
95 ٪CI: 1.2 - 6.3

22%

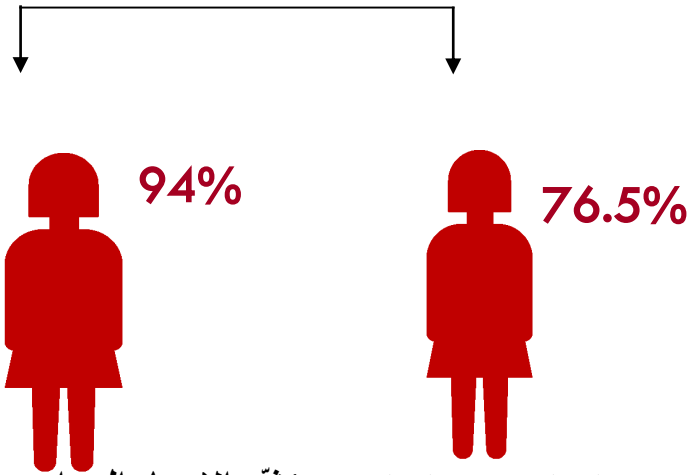
الجهاز البولي التناسلي و مؤشّر الإجهاد الحراري / الأمراض الناتجة عن الاحترار

87%

الاحترار وقلة المراحيض

لم تحصل قرابة 597امرأة على إمكانيّة الوصول إلى المراحيض في العمل.

66%



مشاكل جهاز البول
نسبة معدّلة * 1.5
95 ٪CI: 1.1 - 2.1

76.5%

مؤشّر الإجهاد الحراري و الأمراض الناتجة عن الاحترار
نسبة معدّلة* 1.7
95 ٪CI: 1.2 - 2.7

94%

ملحوظة ∞ *بمعدلة حسب العمر والتعليم و SES ومؤشر كتلة الجسم*

الاحترار واضطرابات العين)العدد ~ 3000)

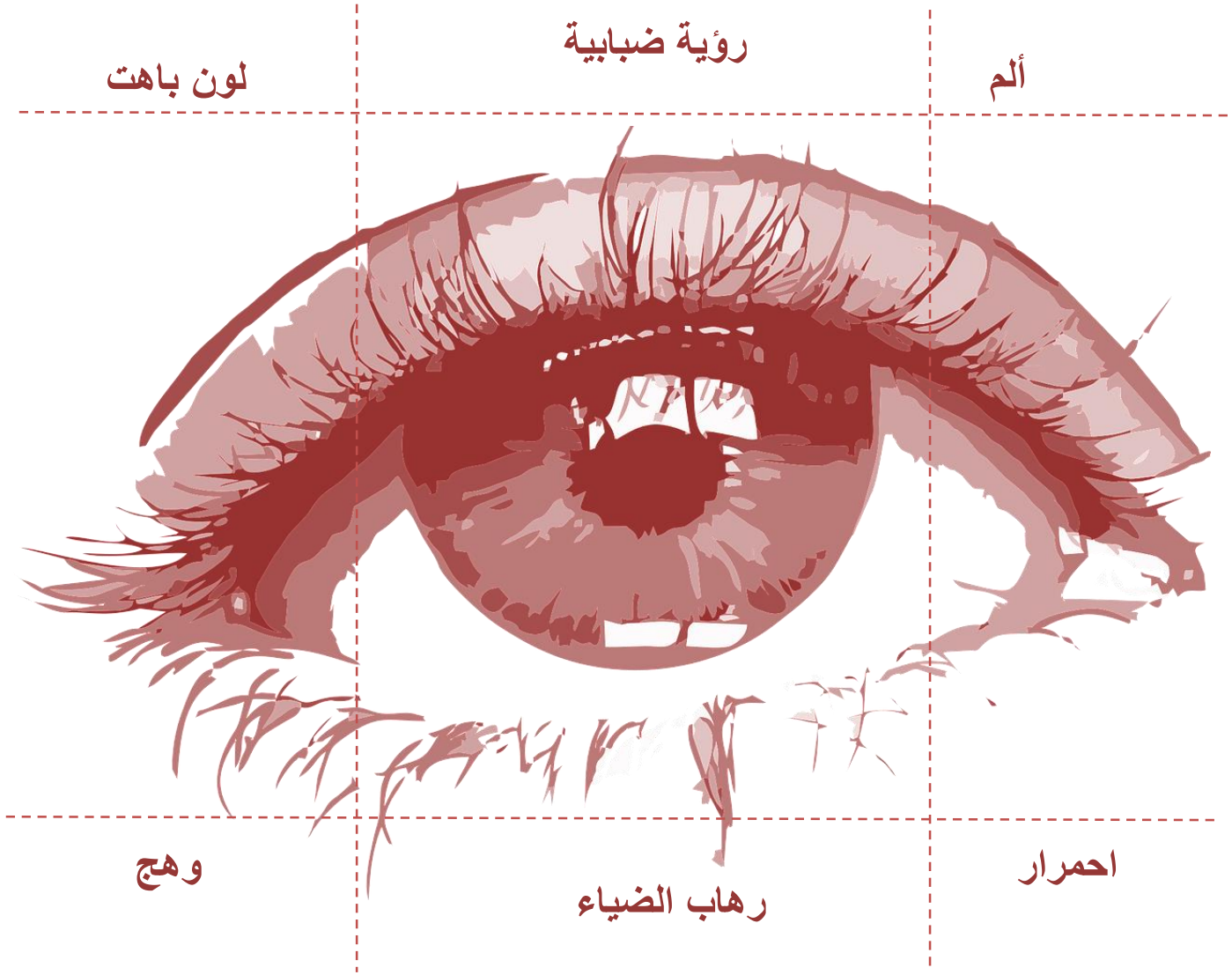
يعاني السكان المعرضون للاحترار من أعراض الأمراض المرتبطة بصحّة العين.

13.3

نسبة الاحتمالات

1.5

CI 1.1 - 1.8



الاحترار والحوادث (N ~ 3000)

تُسجَّل وسط العمال الذين لديهم أعباء عمل ثقيلة نسبة أعلى من الحوادث والإصابات والإعاقات.

13.3

نسبة الاحتمالات

3.8

95 ٪CI: 1.8 - 16.8

النتائج الرئيسية .. ..

التعرض

٪65.2 من العمال يعملون فوق عتبة التعرّض ACGIH-TLV، بما يفوق نسبة العمّال ٪34.8 <الذين يتخطون عتبة التعرّض في الصيف .

التغيّرات الفيزيولوجيّة المقاسة

سُجِّل ارتفاع في مؤشر الإجهاد الحراري بنسبة ٪43.4) (أعلى في **الصيف** وفي صفوف العمال المعرّضين لأعباء **العمل الشديدة.**

تبليغ ذاتي

من بين العمال المعرضين للحرارة ذكرت نسبة ٪92.5 أنها تعاني من **أعراض الإجهاد الحراري** بغض النظر عن الموسم .

٪15 ذكرت **فقدان الإنتاجية**

صحة الكلى

٪49 معدل انتشار eGFR ≤89 مل /دقيقة /1.73 متر مربع **ويرتبط بشكل كبير** بمستوى التعرض للحرارة وفئة العمل والمهنة

صحّة المرأة

عدم وجود **مرافق الصرف الصحي والمراحيض** -عوامل خطر إضافية أبلغت ٪32 عن وجود نتائج سلبيّة على الحمل وكانت مرتبطة بشكل كبير بالتعرض للحرارة بعد ضبط الاضطرابات المحتملة.

الفئات المستضعفة :العمّال غير الرسميين، الذين يؤدون أعباء العمل الشاقة وفي الأماكن المكشوفة

إثبات على تأثير الاحترار في صحّة الكلى

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.org

Original Article

Occupational Heat Stress Impacts on Health and Productivity in a Steel Industry in Southern India

Manikandan Krishnamurthy, Paramesh Ramalingam, Kumaravel Perumal, Latha Perumal Kamalakannan, Jeremiah Chinnadurai, Rekha Shanmugam, Krishnan Srinivasan, Vidhya Venugopal*

Department of Environmental Health Engineering, Sri Ramachandra University, Tamil Nadu, India

ARTICLE INFO

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Keywords:
climate change
health risks
occupational heat stress
productivity loss
steel industry

ABSTRACT

Background: Workers laboring in steel industries in tropical settings with high ambient temperatures are subjected to thermally stressful environments that can create well-known risks of heat-related illnesses and limit workers' productivity.

Methods: A cross-sectional study undertaken in a steel industry in a city nicknamed "Steel City" in Southern India assessed thermal stress by wet bulb globe temperature (WBGT) and level of dehydration from urine color and urine specific gravity. A structured questionnaire captured self-reported heat-related health symptoms of workers.

Results: Some 90% WBGT measurements were higher than recommended threshold limit values (27.2 –41.7°C) for heavy and moderate workloads and radiational heat from processes were very high in blooming-mill/coke-oven (67.6°C globe temperature). Widespread heat-related health concerns were prevalent among workers, including excessive sweating, fatigue, and tiredness reported by 50% workers. Productivity loss was significantly reported high in workers with direct heat exposures compared to those with indirect heat exposures ($\chi^2 = 26.1258$, degrees of freedom = 1, $p < 0.001$). Change in urine color was 7.4 times higher among workers exposed to WBGTs above threshold limit values (TLVs).

Conclusion: Preliminary evidence shows that high heat exposures and heavy workload adversely affect the workers' health and reduce their work capacities. Health and productivity risks in developing tropical country work settings can be further aggravated by the predicted temperature rise due to climate change, without appropriate interventions. Apart from industries enhancing welfare facilities and designing control interventions, further physiological studies with a seasonal approach and interventional studies are needed to strengthen evidence for developing comprehensive policies to protect workers employed in high heat industries.

PDF

0223 Occupational heat exposures in industries and renal health – findings from india FREE

Vidhya Venugopal , Latha Kamalkannan , Rekha Shanmugam , Manikandan Krishnamoorthy , Jeremiah Chinnadurai , Kumaravel Perumal

Abstract

Statement of the Problem: Workers labouring in high thermally stressful environments are subjected to heat-strain and risks of heat-related health issues.

Methodology A cross-sectional study was conducted with ~700 workers engaged in heavy/moderate labour from various organised occupational sectors in India. Wet Bulb Globe Temperatures(WBGT) and heat-strain indicators such as Core-body-temperature(CBT), Heart-Rate(HR), Sweat-Rate(SwR), Urine-Specific-Gravity(USG) were measured. A questionnaire captured self-reported health symptoms of workers.

Findings About 73% of the WBGT measurements were above prescribed limits(Range:26.5°C–38.7°C) and WBGT>31.0°C was associated with significantly more heat-related health concerns among workers(89% vs 34%). Measured heat-strain indicators were above accepted levels for 60% workers, 72% had symptoms of dehydration and 49% suffered from urogenital issues. Workers had 1.4 times higher odds of heat-strain at WBGTs>29.0°C(CI 1.06 to 1.95; p=0.019), that was more pronounced during hotter seasons (CI 1.41 to 2.53; OR=1.9, p<0.0001) with significant increases in heat-related illnesses(X2=66.088; p=4.311e-16) and productivity losses(X2=62.68;p=0.024*1012). High prevalence of kidney stones and adverse renal issues(9%) in steel industry was significantly associated with years of chronic heat exposures(t=−2.3823, df=66.628, p-value=0.02006, 95% CI 0.44–0.03).

Conclusion The results demonstrate that high-heat conditions and minimum cooling interventions that are common in many occupations could create a 'silent epidemic' of kidney-related illnesses without appropriate work practices in tropical settings. The study results warrant an urgent need for further in-depth research with a multi-targeted seasonal approach to identify causalities and to develop and implement appropriate preventive measures to avert adverse effects of heat on the working population in the rising temperature scenario as Climate Change proceeds.

إثبات على تضرر الحمض النووي نتيجة الاحترار في الأماكن المغلقة والمكشوفة

TEMPERATURE
https://doi.org/10.1080/23328940.2019.1632144

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RESEARCH PAPER

Check for updates

Association between occupational heat stress and DNA damage in lymphocytes of workers exposed to hot working environments in a steel industry in Southern India

Vidhya Venugopal[a], Manikandan Krishnamoorthy[a], Vettriselvi Venkatesan[b], Vijayalakshmi Jaganathan[b], Rekha Shanmugam[a], Karthik Kanagaraj[b], and Solomon F. D. Paul[b]

[a]Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education & Research (DU); [b]Department of Human Genetics, Sri Ramachandra Institute of Higher Education & Research (DU), Chennai, India

ABSTRACT

Occupational heat stress apart from adverse heat-related health consequences also induces DNA damage in workers exposed to high working temperatures. We investigated the association between chronic heat exposures and Micronuclei (MN) frequency in lymphocytes of 120 workers employed in the steel industry. There was a significant increase in the MN-frequency in exposed workers compared to the unexposed workers (**$X^2 = 47.1$; $p < 0.0001$**). While exposed workers had higher risk of DNA damage (**Adj. OR = 23.3, 95% CI 8.0–70.8**) compared to the unexposed workers, among the exposed workers, the odds of DNA damage was much higher for the workers exposed to high-heat levels (**Adj. OR = 81.4; 95% CI 21.3–310.1**) even after adjusting for confounders. For exposed workers, years of exposure to heat also had a significant association with higher induction of MN (**Adj. OR = 29.7; 95% CI 2.8–315.5**). Exposures to chronic heat stress is a significant occupational health risk including damages in sub-cellular level, for workers. Developing protective interventions to reduce heat exposures is imperative in the rising temperature scenario to protect millions of workers across the globe.

ARTICLE HISTORY
Received 23 December 2018
Revised 3 June 2019
Accepted 7 June 2019

KEYWORDS
Occupational heat stress; physiological strain; DNA damage; lymphocyte; micronucleus

Introduction

Globally, a rise in temperatures has paved the way for health threats for millions of people [1,2]. Excess heat exposures is not only an environmental threat but also an occupational hazard for a large worker population engaged in hard manual labor in tropical settings [3] exposed to heat stress and strain [4]. Workers in high-heat industries such as iron and steel, foundries, smelters, brick-firing and ceramic, glass and rubber, bakeries, commercial kitchens, and mining are already subjected to high heat exposures on a day-to-day basis and have high potential for heat-related illnesses like heat exhaustion, heat stroke, and death [5–9] which is likely to increase in the future climate change scenario [10,11].

According to the reports of global climate risk index [12], India is classified under the most vulnerable regions exposed to extreme weather conditions with resulting huge economic loss due to heat-induced decreased health, work capacity, productivity consequences, and fatalities [8,13,14]. In particular, the southern region is most influenced by climatic fluctuations [15], has high-heat conditions for the most part of the year that largely influences the indoor workplace temperatures [16] further worsened by heat generated from the processes with consequent undesirable health and productivity [10,17–19].

Earlier reports have shown that heat stress not only inhibits DNA repair processes but can also act as a DNA damaging agent [20,21]. Some animal and human studies concluded that oxidative stress is the main factor responsible for DNA damage caused by heat stress [20,22]. The oxidative stress and resultant altered cellular redox environment within the cells cause protein degradation, DNA damage, cell death [23], compromised sperm quality and an increased risk of infertility [24,25]. It was reported that workers exposed to high heat conditions had high levels of DNA damage and over-expression of HSP70 levels [26,27]. Rocket et al. [28] showed that the expression of a number of DNA repair genes such Ogg1, XPG and Rad54 were all down-regulated when DNA

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IOP Publishing Environ. Res. Lett. 16 (2021) 065006 https://doi.org/10.1088/1748-9326/ac1469

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

Heat-health vulnerabilities in the climate change context—comparing risk profiles between indoor and outdoor workers in developing country settings

Vidhya Venugopal*, Rekha Shanmugam and Latha Perumal Kamalakkannan
Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education and Research, No: 1, Ramachandra Nagar, Porur, Chennai, Tamil Nadu 600116, India
* Author to whom any correspondence should be addressed.
E-mail: vvidhya@ehe.org.in

Keywords: climate change, occupational heat stress, physiological heat strain, dehydration, indoor organized sector, outdoor unorganized sector

Abstract

Occupational heat stress is a crucial risk factor for a range of Heat-Related Illnesses (HRI). Outdoor workers in unorganized work sectors exposed to high ambient temperatures are at increased risk in developing countries. We aim to compare HRI, Productivity Loss (PL), and reduced renal health risk between workers from outdoor unorganized ($N = 1053$) and indoor organized ($N = 1051$) work sectors. Using descriptive methods and a large epidemiological cross-sectional study using mixed methods, we compared risk patterns between the two groups. We analyzed the risk of self-reported HRI symptoms, Heat Strain Indicators (HSIs), PL, and reduced kidney function using Multivariate Logistic Regression (MLR) models. Although Wet Bulb Globe Temperature (WBGT) exposures were high in both the outdoor and indoor sectors, significantly more Outdoor Unorganized Workers (OUWs) reported heat stress symptoms (45.2% vs 39.1%) among 2104 workers. OUWs had a significantly higher share of the heavy workload (86.7%) and long years of heat exposures (41.9%), the key drivers of HRIs, than the workers in indoor sectors. MLR models comparing the indoor vs outdoor workers showed significantly increased risk of HRI symptoms (Adjusted Odds Ratio) ($AOR_{outdoor} = 2.1$; 95% C.I:1.60–2.77), HSI ($AOR_{outdoor} = 1.7$; 95% C.I:1.00–2.93), PL ($AOR_{outdoor} = 11.4$; 95% C.I:7.39–17.6), and reduced kidney function (Crude Odds Ratio) ($COR_{outdoor} = 1.4$; 95% C.I:1.10–1.84) for the OUWs. Among the heat-exposed workers, OUW had a higher risk of HRI, HSI, and PL even after adjusting for potential confounders. The risk of reduced kidney function was significantly higher among OUWs, particularly for those with heat exposures and heavy workload ($AOR_{outdoor} = 1.5$; 95% C.I: 0.96–2.44, $p = 0.073$) compared to the indoor workers. Further, in-depth studies, protective policies, feasible interventions, adaptive strategies, and proactive mitigation efforts are urgently needed to avert health and productivity risks for a few million vulnerable workers in developing nations as climate change proceeds.

منشورات بشأن الاحترار وصحة المرأة

CLIMANOSCO
Climate Science for Everyone

Heat stress and inadequate toilet access at work places in India – a potential hazard to working women in a changing climate

By Vidhya Venugopal, Rekha Shanmugam, Priscilla Johnson, Rebekah Ann Isabel Lucas and Kristina Jakobsson, 1 October 2019

Article information

Cite as: Vidhya Venugopal, Rekha Shanmugam, Priscilla Johnson, Rebekah Ann Isabel Lucas and Kristina Jakobsson, Heat stress and inadequate toilet access at work places in India – a potential hazard to working women in a changing climate, *Climanosco Research Articles* 2, 1 Oct 2019

RESEARCH

In the past few decades, increasingly blistering heat d
change has created more illnesses and claimed more
issue mostly ignored because it's an invisible hazard
document disaster. Victims are usually vulnerable populations, including workers exposed on a daily basis to heat, who not only suffer from heat illnesses but also from an exacerbation of existing health problems aggravated by heat and dehydration. Research has proved that heat is a

and Research (deemed to be University), Chennai, Tamil Nadu, India
Rekha Shanmugam, Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education

Global Health Action

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Glob Health Action. 2016; 9: 10.3402/gha.v9.31945. PMCID: PMC5025522
Published online 2016 Sep 14. doi: 10.3402/gha.v9.31945 PMID: 27633034

Heat stress and inadequate sanitary facilities at workplaces – an occupational health concern for women?

Vidhya Venugopal,[1,*] Shanmugam Rekha,[1] Krishnamoorthy Manikandan,[1] Perumal Kamalakkannan Latha,[1] Viswanathan Vennila,[1] Nalini Ganesan,[2] Perumal Kumaravel,[1] and Stephen Jeremiah Chinnadurai[1]

Background

Health concerns unique to women are growing with the large number of women venturing into different trades that expose them to hot working environments and inadequate sanitation facilities, common in many Indian workplaces.

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International Journal of Medical and Health Sciences
Vol:17, No:07, 2023

Heat Stress a Risk Factor for Poor Maternal Health- Evidence from South India

Authors : Vidhya Venugopal, Rekha S.

Abstract : Introduction: Climate change and the growing frequency of higher average temperatures and heat waves hav
detrimental health effects, especially for certain vulnerable groups with limited socioeconomic status (SES) or physiologica
capacity to adapt to or endure high temperatures. Little research has been conducted on the effects of heat stress on pregnan
women and fetuses in tropical regions such as India. Very high ambient temperatures may worsen Adverse Pregnanc
POs) and are a major worry in the scenario of climate change. The relationship between rising temperatures an
better understood in order to design more effective interventions. Methodology: We conducted an observationa
involving 865 pregnant women in various districts of Tamil Nadu districts between 2014 and 2021. Physiologica
dicators (HSI) such as morning and evening Core Body Temperature (CBT) and Urine Specific Gravity (USG
ed using an infrared thermometer and refractometer, respectively. A validated, modified version of the HOTHAP
was utilised to collect self-reported health symptoms. A follow-up was undertaken with the mothers to collec
regarding birth outcomes and APOs, such as spontaneous abortions, stillbirths, Preterm Birth (PTB), birt
, and Low Birth Weight (LBW). Major findings of the study: According to the findings of our study, ambien
(mean WBGT°C) were substantially higher (>28°C) for approximately 46% of women performing moderate dail
82% versus 43% of these women experienced dehydration and heat-related complaints. 34% of women had US
ch is symptomatic of dehydration. APOs, which include spontaneous abortions, were prevalent at 2.2%
erm birth/birth abnormalities were prevalent at 2.2%, and low birth weight was prevalent at 16.3%. Wit
WBGT>28°C, the incidence of miscarriage or unexpected abortion rose by approximately 2.7 times (95% C
ddition, higher WBGT exposures were associated with a 1.4-fold increased risk of unfavorable birth outcome
nce Interval [CI]: 1.02-1.09). The risk of spontaneous abortions was 2.8 times higher among women wh
ring the hotter months (February - September) compared to those women who conceived in the cooler month
nuary) (95% CI: 1.04-7.4). Positive relationships between ambient heat and APOs found in this study necessitat
further exploration into the underlying factors for extensive cohort studies to generate information to enable the formulation
policies that can effectively protect these women against excessive heat stress for enhanced maternal and fetal health.

Keywords : heat exposures, community, pregnant women, physiological strain, adverse outcome, interventions
Conference Title : ICOG 2023 : International Conference on Obstetrics and Gynaecology
Conference Location : Ottawa, Canada
Conference Dates : July 03-04, 2023

تستوجب اتخاذ إجراءٍ طارئٍ

مع أو بدون دليل ـتدخل عاجل

دراسات التدخل التي أجراها شركاء في الدراسة .....

مشروع الوقاية من الاحترار

خطة العمل لمواجهة مشكلة الاحترار

الفئات الضعيفة

الفعالية

- **التغيير في مستويات التعرض للاحترار وتقييم الاستجابة لها** (تصور العامل، حلقات حول الأمراض الناتجة عن للاحترار HRI، حصر النفقات .تحسين الكفاءة، المؤشرات الفيزيولوجيّة)
- التعريف بالحالات المنشورة (Wegman et al.، 2018)
- ما هو **مقبول** **عملي** ومستدام ؟

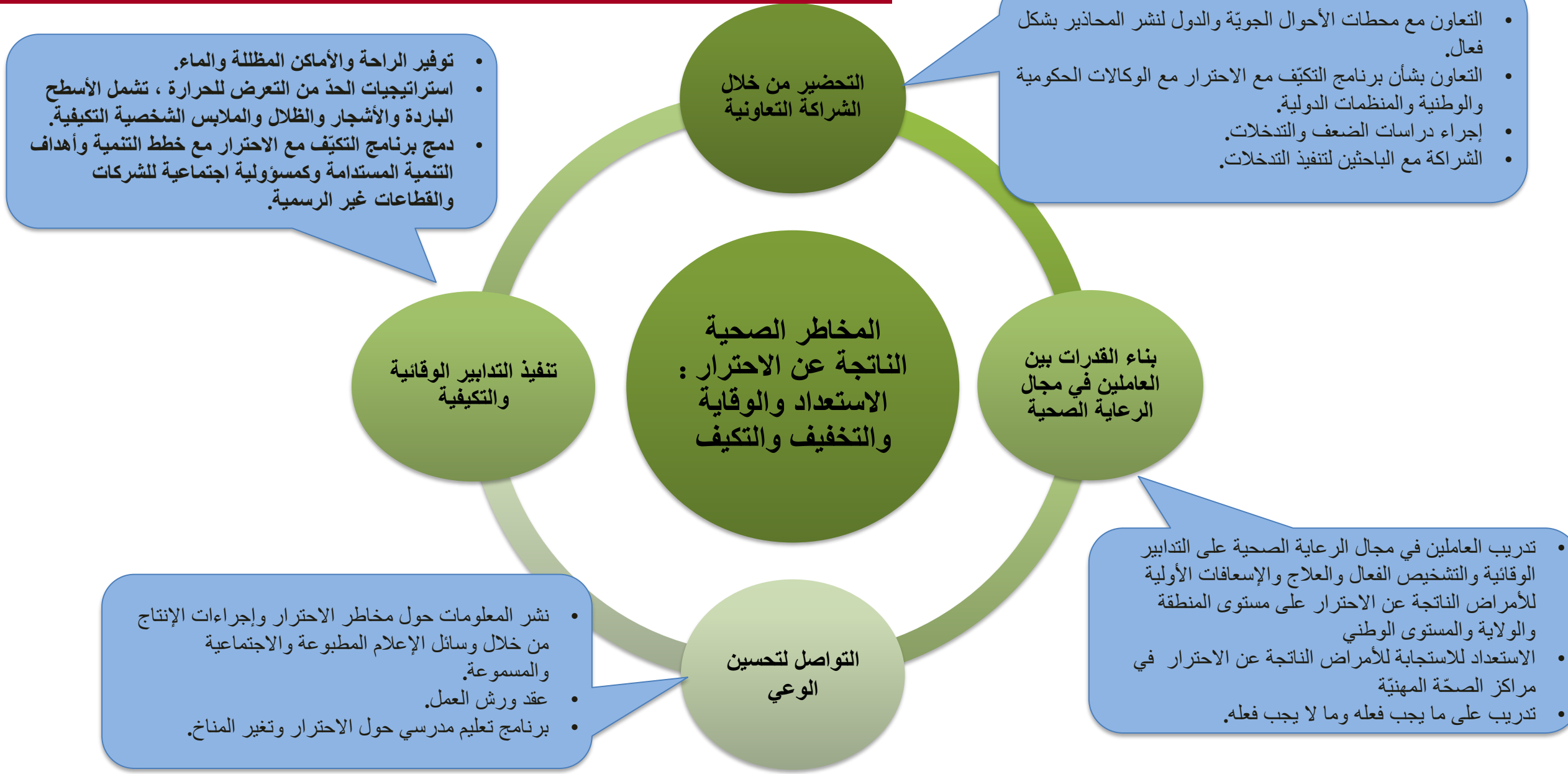
طرق التنفيذ

- **موجات الحر**: إنذار مبكر وتعزيز الظروف الصحيّة.
- **تدخلات مصممة** بحسب الاحتياجات الفردية واحتياجات مكان العمل .
- **مكان العمل المكشوف**: أماكن الراحة والشرب والأماكن المظللة والصرف الصحّي -غلاسر وفلوريس
- ملاط الجليد والملابس -جايسون لي
- **مكان العمل المغلق**: النظافة الصناعية

فهم المشكلة والاحتياجات

- **تحديد** العمّال المعرضين للاحترار
- **توعية** **أصحاب المصلحة** حول الأمراض الناتجة عن الاحترار، وأعراضها، وآلية التكيف، إن وجدت.
- مراقبة تعرّض **العمّال للاحترار التراكمي** والأمراض الناتجة عن الاحترار/مؤشرات الإجهاد الحراري وأمراض الكلى المزمنة.
- **مراقبة** التدخلات الحالية والحلول المجدية
- **أصحاب المصلحة** عليهم التدخل في مكان العمل لمعالجة مشكلة الاحترار

مشروع الوقاية من الاحترار



تدخل بالتعاون مع .....

أكاديميين

- مختبر (FAMEقسم علوم التمرين بجامعة ثيساليا (، اليونان
- جامعة سنغافورة الوطنية
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