

The Deputy Director General

Maisons-Alfort, 18 May 2016

OPINION **of the French Agency for Food, Environmental** **and Occupational Health & Safety**

on the "Assessment of the health risks associated with night work"

ANSES undertakes independent and pluralistic scientific expert assessments.

ANSES's public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are made public.

This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated..... shall prevail.

On 22 March 2011, ANSES received a formal request from the French Confederation of Christian Workers (CFTC) to undertake the following expert appraisal: "Assessment of the health risks for professionals exposed to atypical working hours, especially at night".

1. BACKGROUND AND PURPOSE OF THE REQUEST

The request for an assessment of the risks for professionals exposed to atypical working hours comes within a specific socio-economic and scientific context: the way in which work is organised is changing, leading today to an enormous number of workers being concerned by so-called "atypical" working hours and rhythms.

The expression "atypical hours" applies to all working time arrangements situated outside the framework of the "standard" week¹. The best known forms of atypical hours are shift work², night work and weekend work. Atypical hours also include non-contiguous working hours, compressed work schedules and working hours that can change from day to day.

The adoption of the proposed law on professional equality of men and women in 2001 removed the legal ban on women working at night, mainly to bring French law into compliance with European law and transpose European Directive 93/104/EC concerning certain aspects of the organisation of working time.

¹ Working hours between 5am and 11pm, 5 days a week, at a rate of 8 hours daily.

² Shift work (i.e. work in successive teams) concerns employees forming different teams that take over from each other on a given workstation without ever overlapping. This way of organising working time is intended to ensure continuity on a given workstation.

The number of night workers has almost doubled in twenty years, as can be seen in the latest study by the Directorate for Research, Studies and Statistics (DARES) of the French Ministry of Labour, published in August 2014.

Night work is accompanied by a desynchronisation of biological, social and family rhythms, which can then have an impact on the state of health.

The International Agency for Research on Cancer (IARC) studied the impact of this organisation of work on the risk of cancer, leading it to add shift work that disrupts circadian rhythms to the list of agents that are "probably carcinogenic" (Group 2A) in 2007.

In France in 2012, the French National Authority for Health (HAS) published recommendations on good practices for monitoring shift and/or night workers.

The health effects associated with atypical working hours constitute a complex field of study that requires the application of a wide variety of scientific disciplines. Many effects are mentioned in the literature and mainly concern:

- sleep disorders and reduced alertness;
- gastro-intestinal diseases;
- the occurrence of accidents;
- fertility, reproduction and pregnancy;
- cancer (especially breast cancer in women);
- metabolic disorders and cardiovascular diseases.

In this context, on 22 March 2011, ANSES received a formal request from the French Confederation of Christian Workers (CFTC) to conduct an assessment of the health risks for professionals exposed to atypical working hours, especially those subject to night work, whether or not this is regular. In its request, the CFTC asked whether the conclusions issued by the IARC in 2007 could be broadened to all workers subjected to atypical hours.

Taking into account, on the one hand, the magnitude and complexity of the issue, but also, on the other hand, the existence of new scientific data published since the IARC monograph was issued in 2010, in particular concerning the effects of light on circadian rhythms, ANSES then proposed answering the question in two steps:

- initially, by carrying out an update of the expert appraisal relative to the health risks to which professionals are exposed when working night hours³;
- subsequently, by studying specifically, according to the data available, the health effects potentially associated with other forms of atypical working hours.

2. ORGANISATION OF THE EXPERT APPRAISAL

ANSES entrusted the expert appraisal to the working group on "Assessment of the health risks for professionals exposed to atypical working hours, especially night work", under the auspices of the Expert Committee (CES) on "Physical agents, new technologies and development areas".

The working group was set up on 8 August 2012. It met 27 times in plenary sessions between 14 November 2012 and 26 January 2016.

The collective expert appraisal was mainly based on a critical analysis and summary of the data published in the literature (scientific articles, reports, etc.). The working group studied the health effects, as well as the socio-economic aspects associated with night work. The risk assessment method applied by the Working Group was based on the following main steps:

- a literature search;

³ Night work is defined by Article L.3122-29 of the French Labour Code as "any work performed between 9pm and 6am".

- prioritisation of health effects;
- analysis of the publications identified;
- assessment of the evidence for each effect studied.

The Working Group also interviewed external experts (a total of nine hearings including three with stakeholders) likely to provide useful information and additional data for the expert appraisal.

An international consultation was organised with national agencies and authorities in the areas of health and/or occupational safety, in Europe and in North America, in order to identify studies conducted abroad on the theme of night work and find out which particular health effects were studied.

Lastly, a Research and Development Agreement (CRD) was established between ANSES and the French National Institute for Health and Medical Research (INSERM), with the aim of exploiting field data from the national survey on "Medical surveillance of exposure to occupational hazards" (Sumer, 2010).

The methodological and scientific aspects of this group's work were regularly submitted to the CES. The report produced by the working group takes account of the observations and additional information provided by the CES members. This expert appraisal was therefore conducted by a group of experts with complementary skills. It was carried out in accordance with the French Standard NF X 50-110 "Quality in Expertise Activities".

ANSES analyses the links of interest declared by the experts prior to their appointment and throughout the work, in order to avoid potential conflicts of interest with regard to the matters dealt with as part of the expert appraisal.

The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

The Expert Committee on "Physical agents, new technologies and development areas" adopted the collective expert appraisal work along with its conclusions and recommendations as described in this collective expert appraisal summary, at its meeting of 15 March 2016. One of its members abstained from the vote on the validation of the collective expert appraisal summary, referring, apart from their substantive agreement, to reservations on the editorial form.

3. ANALYSIS AND CONCLUSIONS OF THE CES

The reality of night and/or shift work in France

An analysis conducted by the DARES⁴ based on data from the "Working conditions" survey of 2012 revealed that 15.4% of employees (21.5% of men and 9.3% of women), or 3.5 million people, worked at night, regularly or occasionally. These figures are on an upward trend, with the increase being particularly sharp for women. Night work is most widespread in the tertiary sector, and concerns 30% of public-sector employees and 42% in private services companies. Drivers of vehicles, police and military personnel, nurses, care assistants and skilled workers in processing and/or assembly industries are the professional categories most concerned by night work. Temporary workers, men in their thirties and women under 30 years of age are the groups most frequently working at night.

Again according to the "Working conditions" survey of 2012, employees who work at night have higher remuneration but markedly more difficult working conditions than other employees: they are subjected to more numerous physical hardship factors, greater time pressure (hours, rhythm constraints, deadlines, etc.), and more frequent tensions with their colleagues or the public.

A clear regulatory framework for night work

⁴ Source DARES, Analyses, Le travail de nuit en 2012 [Analyses, Night Work in 2012] No. 062, August 2014

French legislation (Article L. 3122-29 of the Labour Code) defines *night work* as "any work performed between 9pm and 6am". It also defines a *night worker* as any worker who performs a fraction of their working time between 9pm and 6am: at least 3 hours twice a week, or at least 270 hours over twelve consecutive months⁵. These definitions may be modified within certain limits by collective agreement or extended agreement. This strict regulatory framework is modulated by numerous waivers, depending on the sectors and professions concerned.

According to Article L. 3122-32 of the French Labour Code, the use of night work must remain exceptional and take into account the requirements to protect the health and safety of workers. It must also be justified by the need to ensure the continuity of economic activity or services of social value.

The status of night worker includes compensatory measures (for example in terms of rest and salary), as well as provisions designed to protect employee health, mainly by limiting the maximum duration of the work, although these provisions are modulated by numerous waivers. In addition, a series of specific measures have been adopted, aimed at preventing health risks for pregnant women when they perform night work.

Shift work is not defined in the French Labour Code; it is therefore far less regulated. The provisions specific to shift work are, for the most part, laid down in collective professional agreements and collective branch agreements.

Socio-economic aspects of night work

Night work may be introduced to ensure the continuity of services of social value, such as health services and on-call police officers or other surveillance services, or it may be a work organisation method, for example for a company that wishes to maximise the profitability of its equipment by getting machines and people to work around the clock.

The social cost of night and/or shift work is not limited to the health care provided to employees but should also take into account the cost of the impact on family life, costs induced by transport, and absenteeism. This social cost of night and/or shift work is however very difficult to assess, because there are very few statistics associating the medical and social consequences with the working hours.

While the health effects of atypical hours, and in particular night work and shift work, have been documented in the scientific literature, the same is not true for the record of the employees' life outside work. Indeed, although since the 1980s some researchers have been warning of the need to begin examining this field of research, few scientific studies have focused on the impact of these hours on family and social life. Life outside work is undeniably linked to health as defined by the WHO, i.e. physical, mental, psychological and social⁶.

⁵ Art. R. 3122-8 of the French Labour Code

⁶ According to the World Health Organisation (WHO), "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

Concerning the effect of night and shift work on social life

Shift or night work creates a limitation on social life because of the time mismatch between the shift worker's rhythm of life and that of society as a whole. It is therefore not so much a lack of free time that causes difficulty but its position on the nycthemeron⁷. This is manifested by: difficulties in organising social encounters resulting in a tendency to spend more time with colleagues with a similar rhythm of life, difficulty accessing social activities in a structured framework (cultural, sports, associations) due to their strong rooting in a rigid and socially predetermined time period, and a tendency to opt for more individual and flexible leisure activities requiring no synchronisation with others. The diversity of shift work situations, organisational specifics, the variety of social contexts, the weight of individual characteristics, all constitute key factors that determine how people go about their lives outside the workplace.

Concerning the effect of night and shift work on family life

Depending on how it is organised, shift work may, for couples, result in limited time for meeting and sharing, changes to marital relations and sex life, and the emergence of imbalances in the functioning of the family that are felt more acutely by their spouses than by the employees themselves. In the long term, these difficulties can also be manifested by psychological disorders associated with guilt and frustration, the recurrence of inter-marital tensions and changes in the state of health. Some research relating to the impact of shift work on relations between shift workers and their children shows a decrease in the frequency and duration of family interactions and in the perceived quality of parenthood, as well as a deterioration in the nature and quality of parental functions. However, the effects of night work on the socio-familial environment are not universal and their assessment therefore requires the employment conditions of the households and the economic and cultural context of the country to be taken into consideration.

Health effects of night work

1. Effect on the quantity and quality of sleep

The difficulties experienced by night workers in falling asleep after a period of work at irregular hours are easily understandable and often recognised by all the parties in the world of work. Night work is accompanied by a need for the reorganisation of biological rhythms, of which sleep is the most sensitive to these environmental conditions of irregular hours.

On the physiological level, during night work, a desynchronisation occurs between the circadian rhythms that are aligned with daytime hours, and the new activity-rest/awake-asleep cycle imposed by the night work. This desynchronisation is also promoted by environmental conditions that are not conducive to sleep: daylight during rest, temperature usually higher than at night, higher noise levels during the day, social and family obligations. All these physical and sociological environmental factors contribute to disrupting the biological rhythms and sleep. The sleep difficulties reported by night workers concern both the quality and quantity of sleep.

Experimental studies in humans using actigraphy⁸ and polysomnography⁹ show a reduction in sleep time among night workers.

The evidence from epidemiological studies is sufficient to conclude that there is an effect on the health of workers.

Accordingly, the effect of night work on sleep quality and the reduction of sleep time is proven.

⁷ Physiological unit of time lasting 24 hours, comprising one night and one day, a period of sleep and a period of wakefulness.

⁸ This test involves measurement and recording using an actigraph attached to the wrist. It is used to determine the patient's activity/rest rhythm over several weeks (evaluation of their phase shifts, or the quantity and especially quality of sleep).

⁹ Polysomnography is the complete recording of sleep. This examination involves capturing the electric rhythms coming from a patient's body in order to deduce the stages of sleep.

2. Sleepiness and cognitive disorders

The studies carried out in the laboratory have shown that circadian desynchronisation is accompanied by cognitive impairment. The sleepiness associated with these symptoms is explained by both the desynchronisation of the working day compared to the circadian clock, and the "sleep debt" developed by shift and night workers.

- Sleepiness

The evidence provided by epidemiological studies is sufficient to conclude that there is an effect.

In addition, many fundamental studies in humans (mechanistic studies in the laboratory) have also observed this proven sleepiness whose intensity depends on the rhythm of shift work (including at night) but also chronobiological and homeostatic factors related to sleep debt, depending on the reduction in sleep time and the time interval between the last sleep episode and the beginning of the work period.

Accordingly, the effect of night work on sleepiness is proven.

- Cognitive performance

While most studies use the objective measurement known as the PVT (Psychomotor Vigilance Test), which measures reaction time, a few offer other interesting assessment methods. Of the eleven studies analysed, six show that shift work, including night work, may be associated with a decline in cognitive performance. However, some studies show that the decrease in psychomotor performance in the PVT may be more affected by sleep deprivation prior to starting the shift than by the actual time of the shift. There is limited evidence from epidemiological studies to conclude as to whether or not there is an effect.

The fundamental studies conducted in humans with shift work simulated in the laboratory confirm the effects of these irregular hours on cognitive performance, in particular, but not exclusively, assessed by the PVT.

Accordingly, the effect of night work on cognitive performance is probable.

3. Effect on psychological health

Night workers collectively report problems with their psychological health: mood disorders, depression, irritability, anxiety and personality disorders. Long regarded as a consequence of mental disorders, changes to the circadian system could actually be involved in causing these disorders. Indeed, the direct involvement of changes to the circadian system – and therefore potentially night work – in the development of mental illnesses is currently being proposed in some studies.

Night work may influence psychosocial risk factors and sleep disorders, which in turn could increase the risk of mental disorders. The consequence of this result is that controlling for confounding factors is essential to determine the nature of the effect of the night work itself. As there are so many of these confounding factors, they are never all controlled in any one study.

The data show an association in the majority of studies, with the exception of the only longitudinal study available, for which it is not possible to exclude all the biases and confounding factors. Thus, the evidence supporting the existence of an effect of night work on mental health is limited.

A recent experimental study (Boudreau *et al.*, 2013) conducted with shift workers in the laboratory reported better mood quality when there was an increase in circadian synchronisation (between the internal biological clock and the wakefulness-sleep schedule imposed by night work). This

laboratory study also provides limited evidence supporting the existence of an effect of night work on mental health.

Accordingly, the effect of night work on psychological health is probable.

4. Metabolic disorders and cardiovascular diseases

Many studies have been conducted to assess the association between shift work and the risk of metabolic disorders: obesity or overweight, diabetes, high blood pressure, dyslipidaemias or metabolic syndrome.

- Obesity and overweight

Several of the studies analysed, in particular the case-control studies, showed a significant association between shift work, including night work, and weight gain. There is limited evidence provided by the epidemiological studies to conclude as to whether or not there is an effect.

Studies suggest that the increase in food intake (generally sweet) may be a compensatory homeostatic response to sleep deprivation, which is observed in shift work with night hours.

Taking into account the evidence provided by the epidemiological studies and the plausible mechanisms from experimental studies, *the effect of night work on obesity and overweight is probable.*

- Type 2 diabetes

A significant dose-response relationship between the duration of shift work, including night work, and the risk of type 2 diabetes was shown in two cohort studies analysed. In the different studies selected, it was shown that shift work is associated with a significantly increased risk of type 2 diabetes, particularly among shift workers on rotating hours. The evidence in the epidemiological studies is limited.

On the mechanistic level, the effects of circadian disruption and/or sleep restriction on insulin-resistance are plausible. In the majority of studies testing the effect of circadian disruption in humans or animals, impaired glucose metabolism, as well as sensitivity to insulin, were observed.

Thus, taking into account the evidence provided by the epidemiological studies and the plausible mechanisms from experimental studies, *the effect of night work on diabetes is probable.*

- Dyslipidaemias

Epidemiological studies on this subject mainly focused on minimum and mean values in years of rotating shift work, resulting in an increase in cholesterol. However, most of these studies do not take into account the sub-fractions of cholesterol (HDL-C, LDL-C), or triglycerides. Given the methodological limitations and the few available studies taking these parameters into account, the evidence provided by the epidemiological studies cannot be used to draw any conclusions about the existence or not of any effect.

Taking into account the evidence provided by the epidemiological studies and the plausible mechanisms studied in experimental studies, *the effect of night work on dyslipidaemia is possible.*

- Metabolic syndrome

There are several definitions of metabolic syndrome. One of the most recent (2005) defines this syndrome as the simultaneous presence of at least three out of five criteria on biological and clinical parameters related to waist size, blood pressure, blood triglyceride, blood cholesterol and blood sugar levels.

While most of the studies are cross-sectional, several cohort studies are available, including one proposing a higher rate of incidence of metabolic syndrome for shift workers, including night workers, compared to day workers.

Concerning the epidemiological studies, there is sufficient evidence to conclude that there is an effect. On the mechanistic level, the effects of circadian disruption and/or sleep restriction on the components of metabolic syndrome are plausible.

The presence of a dose-effect relationship with the duration of the shift work, including night work, has been highlighted in several studies.

Accordingly, the effect of night work on the occurrence of metabolic syndrome is proven.

It should be noted that metabolic syndrome is defined as a combination of several biological or clinical parameters that are not necessarily all disrupted. This explains why the effect on this syndrome is regarded as proven whereas the effects for the diseases taken individually are probable.

- Cardiovascular diseases

The association between night/shift work and cardiovascular disorders is plausible on the basis of the risk factors examined. Nevertheless, it should be noted that most of the studies are affected by selection and information bias. These are related to the imprecise definition and quantification of exposure, the incorrect classification of cases and controls, the type of study (cross-sectional, longitudinal), the groups/sectors examined, the diagnostic criteria, the reporting methods, the confounding and risk factors considered, and the "healthy worker effect" (ageing, recruitment, periodic medical surveillance).

Taking into account the evidence provided by the epidemiological studies and experimental studies in humans examined:

- *the effect of night work on coronary heart diseases (coronary ischaemia and myocardial infarction) is probable;*
- *the effect of night work on high blood pressure and its relationship with ischaemic stroke are possible.*

5. Cancer

The assessment by the IARC of the carcinogenicity of night work causing disruptions to circadian rhythm concluded in 2010 that there was a limited level of evidence in humans, on the basis of eight epidemiological studies on breast cancer in women and a small number of studies on cancers of the prostate, colon and endometrium. Since this assessment, new epidemiological studies have been published.

The evidence provided by the epidemiological studies to assess the cancer risk associated with shift work, including night work, are presented below by cancer site.

This is followed by a global presentation of the assessment of the level of evidence of the risk of cancer associated with shift work, including night work.

- Breast cancer in women

The assessment of the evidence provided by the epidemiological studies focused on 24 studies on breast cancer conducted in North America, Europe and Asia, including the eight studies evaluated in the IARC monograph. Eight cohort studies and seven case-control studies nested in the cohorts focused on nurses (six studies), radio operators, military personnel, textile workers and groups of employees identified in population or employer registers. Nine case-control studies carried out in the general population were also taken into account, covering a wide range of occupations and sectors of activity.

Of all the studies analysed, some had major methodological limitations and did not play a predominant role in the final assessment, due to the inadequate measurement of exposure, the possibility of selection bias of subjects, the small sample size, or the fact that confounding factors were not taken into account. Conversely, some case-control studies in the population or nested in cohorts were given precedence due to their higher methodological quality. These studies generally provided new elements compared to the assessment by the IARC, because they focused on diversified professional groups, the night and/or shift hours were defined more precisely than in the earlier studies, the exposure to night work was measured over the entire professional career, and the main risk factors for breast cancer likely to play a confounding role were taken into account. Lastly, some studies also collected information on the duration of sleep and on the chronotype of individuals as intermediary factors or modifiers of the relationship between night work and risk of breast cancer.

The main studies showed that there were statistical associations, generally low, between breast cancer and night or shift work. However, the definitions used to characterise the exposure to night work vary widely from one study to another and make it difficult, if not impossible, to compare results. Depending on the different studies, the observed associations concerned the duration in years of night work, its intensity (number of nights per week or per month), the number of consecutive nights worked, the total number of nights worked throughout the whole career, fixed or rotating night work, or night work measured on a scale enabling the degree of circadian disruption to be assessed, with long durations of exposure of more than 20 years being associated with breast cancer in some studies, but not in all.

In conclusion, the expert group recognises that the recent epidemiological studies provide new evidence on the possible links between night work and breast cancer. However it underlines the lack of standardisation in the characterisation of exposure. Unless the results can be replicated reliably from one study to another, it is not possible at this stage to draw a coherent picture of the increase in the risk of breast cancer among women working at night or working shifts according to the duration, frequency or intensity of exposure. It also considers that it is not possible to rule out, with certainty, the existence of residual confounding factors, in relation with, for example, concomitant occupational exposure, which could explain some of the observed associations.

The epidemiological studies supporting an effect of shift work, including night work, provide more evidence on the increase in the risk of breast cancer than was available in 2010. This evidence is, however, limited.

- Prostate cancer

The literature review focused on eight epidemiological studies with an individual assessment of exposure to night work or shift work (five cohort studies and three case-control studies), two of which had been taken into account in the IARC monograph. The cohort studies do not report any increase in the risk of prostate cancer associated with night work or shift work, with the exception of the first publication relating to a small Japanese cohort. In these studies, the measurement of exposure to night work is generally not very precise, is based on a short period in the career of the subjects, or is evaluated from a jobs-exposure matrix responsible for ranking errors. Among the three case-control studies, the results show associations with the durations of exposure or indices of cumulative exposure to night work. The most recent study reporting links between night work and the advanced stages of prostate cancer, and studying the modifier effect of the chronotype, provides more convincing evidence, but these elements must be underpinned by new studies.

On the basis of the available epidemiological studies, the results suggest the possibility of an increased risk, but the evidence is insufficient, and must be confirmed by further studies.

- Other cancers

A small number of epidemiological studies have analysed the links between night work and cancers of the ovary, lung and pancreas, and colorectal cancers, as well as several other cancer sites, in particular in the cohort studies. In these studies, the exposure to night/shift work is usually assessed in an imprecise way, and the covariables that can play a confounding role are not systematically taken into account. The results of studies on the same cancer sites reporting

associations with night work are contradictory for a given cancer site.

On the basis of the available epidemiological studies, it is not possible to conclude as to the effects of night work on the other cancer sites.

- Overall conclusion on the risk of cancer

The expert group conducted a critical analysis of the epidemiological studies on the risk of cancer related to shift work, including night work. On this basis, it considers that there are elements supporting an excess risk of breast cancer associated with night work, with limited evidence. It is not possible to conclude as to an effect for the other cancer sites on the basis of the available studies.

The expert group also considered the results of experimental studies in animals examining the links between disruptions caused to the circadian rhythm and the onset of cancer. In addition, it stresses the existence of physiopathological mechanisms that may explain the carcinogenic effects of disruptions to the circadian rhythm.

Based on the results of the epidemiological studies analysed and the results of experimental and biological studies, the CES finds a probable effect of night work on the risk of cancer.

Accidentology and traumatic pathology

The studies examined show that the frequency and severity of accidents occurring during shift work, including night work, are generally higher. This situation is explained both by the physiological mechanisms involved (sleepiness, sleep debt, chronobiology), and by organisational, environmental (working conditions) and managerial factors.

Modulators

The effects of night and shift work on the health of employees subjected to it are not unambiguous and systematic. They depend on a combination of factors based on the employees' individual, social and family characteristics and the characteristics of the work and work situation. These multiple factors will modulate, i.e. reduce or amplify, the effects of night work and shift work on the health of the employees. National surveys also show that night workers accumulate time constraints (work at the weekend, reduced freedom in the organisation of working time, etc.) and hardship factors (alertness constraints, physical hardship). Adaptation strategies put in place by the workers on rotating and night hours in work and "outside work" contribute to the control of risks in terms of work, personal life and health. But they are not always sufficient. The readjustments observed in actual work to anticipate variations in sleepiness, transfers of tasks, mutual assistance and rest are only possible when there is room for manoeuvre in the work situation.

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Table 1: Classification of the health effects studied

| Effect studied | | Is there evidence of the existence of the effect in experimental studies in humans or animals? | Evidence of the existence of the studied effect in clinical and epidemiological studies | Classification of the level of evidence in humans |
|---|---|--|--|---|
| Sleep | Sleep quality | yes | Sufficient | Proven effect |
| | Sleep time | yes | Sufficient | |
| Cognitive performance | Sleepiness and alertness | yes | Sufficient | Proven effect |
| | Cognitive performance | yes | Limited Six studies out of 11 show an association. | Probable effect |
| Psychological health | | yes | Limited Eighteen studies out of 20 show an association between night work (fixed or rotating) and diminished mental health. A more indirect link in the other eight studies is mediated by psychosocial risk factors associated with the content and organisation of night work. | Probable effect |
| Cancer | Breast cancer | yes | Limited There is more evidence supporting an effect of work, including night work, than in 2010; however, it is limited. | Probable effect |
| | Prostate cancer | yes | No conclusion can be drawn | |
| | Other cancers (ovary, pancreas, colorectal) | yes | No conclusion can be drawn | |
| Cardiovascular diseases and metabolic disorders | Metabolic syndrome | yes | Sufficient | Proven effect |

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|--|-------------------------|-----|--|------------------------|
| | Obesity or overweight | yes | Limited Several case-control studies show a significant association with night-shift work One cohort study, despite its methodological limitations, suggests deleterious effects. | Probable effect |
| | Type 2 diabetes | yes | Limited A significant dose-response relationship between the duration of shift work with night hours and the risk of type 2 diabetes was shown in two cohorts. | Probable effect |
| | Dyslipidaemias | yes | No conclusion can be drawn | Possible effect |
| | Coronary heart diseases | yes | Limited Selection and information bias affect most of the studies. | Probable effect |
| | High blood pressure | yes | No conclusion can be drawn | Possible effect |
| | Ischaemic stroke | yes | No conclusion can be drawn | Possible effect |

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

The population concerned by night work, whether regular or occasional, has almost doubled in 20 years. In 2012, it represented 15.4% of employees, or 3.5 million people, and continues to increase. According to Article L. 3122-32 of the French Labour Code, the use of night work must remain exceptional.

The working conditions of employees working at night are more difficult than for others: they are for example subjected to more numerous physical hardship factors, greater time pressure and more frequent tensions with their colleagues or the public.

The Agency emphasises the important work carried out by the expert groups entrusted with the expert appraisal, covering aspects relating to definitions and regulations, and a description of the situation in France. Using a specific method, the assessment of the health risks associated with night work led to the level of evidence for the studied effects being ranked. In a ground-breaking context, this work focused on an expanded description of the health effects associated with this type of activity. The description of the societal and economic contexts of night work supplements this complex expert appraisal and thus shows the importance of taking the social and family aspects into account to understand the issue of the health effects of night work in its entirety. This first part of the Agency's study is devoted to the issue of night work. This study will continue, in accordance with the original formal request, on the more general issue of the other forms of atypical working hours.

ANSES endorses all the conclusions, reiterated in Section 3 of this opinion, and the recommendations of its Expert Committee on "Physical agents, new technologies and development areas".

The results of the expert appraisal highlight the health effects of shift work including night work:

- proven effects on sleepiness, sleep quality and the reduction of total sleep time, and metabolic syndrome;
- probable effects on cancer, psychological health, cognitive performance, obesity and weight gain, type 2 diabetes and coronary heart diseases (coronary ischaemia and myocardial infarction);
- and possible effects on dyslipidaemias, high blood pressure and ischemic stroke.

The Agency reiterates the first principle of removing the hazards to which workers are exposed, in the framework of the general principles of risk prevention laid down by the French Labour Code.

Accordingly, the Agency recommends limiting the use of night work solely to situations where there is a need to ensure the provision of services of social value or the continuity of economic activity. In this context, the Agency notes that there is currently no regulatory definition covering the "continuity of economic activity", used in some cases to justify the use of night work.

Furthermore, the Agency recommends assessing the adaptation of the regulatory framework in force to protect the health of night workers, and modifying it, if appropriate, while taking the European dimension into account.

In addition to ensuring correct application of the regulatory provisions relating to night work, the Agency recommends conducting a review of practices in the field designed to protect the health of night workers (maximum duration of daily work, break times, minimum daily rest, compensatory rest, medical supervision, etc.). This could be achieved, for example, by means of a survey of the main sectors concerned.

In addition, the Agency advocates:

- initially, assessing the health impact of the effects of night work (number of cases for each potential disease in the worker population);
- subsequently, assessing the social costs associated with the use of night work (work stoppages, occupational disease, absenteeism, etc.) that could be set against the potential benefits.

In the meantime, it appears necessary to immediately:

- adjust the medical surveillance of night workers, especially after the cessation of their night work;
- present the conclusions of this expert appraisal to the bodies in charge of assessing the relevance of listing certain pathologies in the occupational diseases table.

The Agency advocates optimising the ways in which night work is organised, in order to minimise the impact on workers' personal and professional lives. The organisational recommendations identified by the Agency's expert groups must therefore be emphasised. In particular, anything that reduces desynchronisation and sleep debt is favourable in principle, but specific organisational recommendations, on which there is currently no scientific consensus, should be examined collectively in the appropriate social dialogue bodies.

Lastly, concerning research on the health effects of night work, the Agency recommends:

- continuing the studies, especially on effects for which the evidence is limited;
- continuing the implementation of epidemiological studies, ensuring that exposure is better characterised (with standardised questionnaires, for example), and better taking into account possible confounding factors;
- conducting experimental studies in humans in the laboratory and in actual conditions, including subjective and quantitative assessments of the impact of night work on the amplitude and phase of the circadian system, sleep, sleepiness, cognition, metabolism, cardiovascular diseases, the immune system, etc.;
- acquiring data on companies (internal reports/grey literature) in order to increase knowledge on the effects of this type of time organisation in an actual work context.

The Deputy Director General

Caroline GARDETTE

KEYWORDS

Health effects:

- changes to the circadian system
- sleep disturbances
- metabolic and hormonal syndromes/disorders (fertility, diabetes)
- cancers
- gastrointestinal effects
- cardiovascular effects
- effects on the immune system
- psychological effects
- cognitive effects

Effects on work:

- cognitive effects
- accidentology (occupational accidents and commuting accidents)
- reliability
- performance
- work activity

Effects on life outside work:

- family life (marital life, relationship with children)
- social life