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French lay Persons' judgments of the possibility of a heart attack when experiencing various physical manifestations

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ABSTRACT

Background: The aim of the study was to characterize the different ways in which, based on certain physical manifestations that an individual suddenly experiences, people judge the possibility that these manifestations indicate the onset of a heart attack.

Methods: One hundred ninety-four French adults–plus six physicians–were presented with a set of realistic vignettes composed by orthogonally crossing the levels of four factors: the type of pain felt, and the presence or absence of nausea, excess sweating, and of difficulty breathing.

Results: Four qualitatively different reactions were found among the lay people. The majority reaction (54%) was close to the physicians' reaction. It consisted of suspecting a heart attack as soon as intense pain occurs in the chest or back. The second reaction (25%) retained from the first one only the idea that a heart attack should be suspected if the pain is localized to the chest. The third reaction (14%) reflected some people's uncertainty in the face of disturbing manifestations that they find difficult to interpret. The fourth reaction (7%) was that no set of symptoms could mean, for them, the onset of a heart attack.

Conclusion: Only about half of the participants appeared to be able to consider unpleasant physical manifestations as a whole and integrate that information into an overall warning judgment that can lead into prompt life-saving actions. We recommend that judgment training on warning symptoms and signs be performed, especially for high-risk patients, in the offices of primary care providers and specialists.

1. Introduction

Cardiovascular diseases are currently responsible for about 30% of deaths in the United States (Center for Disease Control and Prevention, 2021) and about 25% of deaths in France (Santé publique France, 2021). Every forty seconds, an American suffers a heart attack. When distressing physical manifestations experienced by a person–such as chest or back pain, nausea, excessive sweating, and breathing problems–do not quickly lead to the realization that this person may be having a heart attack and that help must be called for urgently, the risks for this person of dying quickly or suffering serious after-effects are considerably increased (Moser et al., 2006). Reducing the time between the appearance of symptoms and the implementation of effective treatments (e.g., thrombolysis) means reducing the time between (a) the appearance of symptoms and the realization of the urgency of the situation (e.g., self-diagnosis of a heart attack), (b) the realization of this urgency and the implementation of appropriate behaviors (e.g., calling the ambulance), (c) the transportation of the patient to the appropriate hospital service (e.g., by using an helicopter if road traffic is heavy), and (d) the arrival at the emergency room and the effective management by a team of caregivers. It is estimated that 75% of lost time is attributable to the first of these four factors (Granot et al., 2014).

Abbreviations: M, Mean; N, Number.

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1.1. People's awareness of symptoms

Birnbach, Höpner and Mikolajczyk (2020) conducted a *meta*-analysis of 86 studies (published from 2008 to 2019) on the ability of people from 34 countries to recognize or evoke physical manifestations indicative of the onset of a heart attack. When a list of conditions was used, 88% recognized chest pain or discomfort, 76% shortness of breath, and 75% pain or discomfort in arm or shoulder as symptoms. The other conditions were recognized by lesser percentages: sweating (64%), feeling weak (59%), back pain (50%), and nausea (28%). When open-ended questions were used, percentages were, overall, lower: 80% evoked chest pain; 60%, pain in arm or shoulder; 49%, shortness of breath; and 44%, sweating. The present study was conducted from a different, functional perspective. When people suddenly experience a set of diverse physical manifestations, how do they integrate the information coming from these manifestations into a personal conviction that they might be experiencing a heart attack?

As in Ratner et al. (2006) and Cytryn et al. (2009), a scenario technique was used. A variety of realistic situations were created in which the participant is depicted as experiencing one or more distressing physical manifestations upon awakening – chest or back pain, sudden sweating, nausea, shortness of breath. The participants were asked to judge the possibility in each case that he or she is having a heart attack. Such an experimental device makes it possible (a) to examine whether they are able to recognize the symptoms of a heart attack, but also (b) to characterize the way in which they integrate the information, in terms of symptomatic manifestations, into a global judgment of likelihood that could lead to concrete action (e.g., calling an ambulance).

Given the diversity of findings reported above, we expected to observe four qualitatively different reactions to the situations described. The first reaction would be that no set of symptoms—regardless of the pain and discomfort they were to imagine experiencing—could mean, for them, the onset of a heart attack. Some would be truly at low risk, others less so. As Weinstein (1988) pointed out, people tend to underestimate their risk of disease. In addition, some people seem to be unaware of the symptomatology of myocardial infarction (Rainer et al., 2006). The second reaction would be hesitancy. Such a reaction was described in a qualitative study conducted by Hwang and Jeong (2012) among hospitalized Korean patients. Some of them indicated that they had difficulty identifying the exact reason for their discomfort and attributed it to other causes (e.g., diabetes). In particular, some participants with an intermittent or progressive development of symptoms or an atypical presentation with low levels of chest discomfort admitted that they had not realized the severity of their symptoms.

The third and fourth expected reactions were directly based on the findings of Hwang et al. (2008) in a sample of Korean immigrants in the Chicago area. Using cluster analysis of participants' responses, they identified two different positions. For a minority (28%), chest pain, back pain, shortness of breath, and weakness were strongly associated with a heart attack. For a majority (72%), however, only the first two symptoms were strongly associated. We expected, therefore, that for some participants in the present study, chest and back pain would indicate the onset of a heart attack, in addition to other distressing physical manifestations, but that, for other participants, only chest pain would indicate a heart attack (Cytryn et al., 2009).

In summary, the present study aims not only to find out whether people recognize diverse physical manifestations as possible symptoms of a heart attack, as in previous works, but also to characterize the possibly diverse cognitive processes by which people integrate this information to arrive at a judgment of the possibility of a heart attack.

2. Method

2.1. Participants

Participants were a convenience sample of 194 adults aged 18 to 87 ($M = 36.05$, $SD = 14.80$). Their demographic characteristics are shown in Table 1. They were approached in the streets of Toulouse, France, and its suburbs by four research assistants (psychology students) specially trained for this type of investigation. The locations chosen were streets facing hospitals or administrative buildings (e.g., post offices). Each assistant had to contact every adult in his or her vicinity until about 50 people agreed to participate. There were no other eligibility criteria. Thirteen were nurses; none of the others worked in health care.

Our experience with previous studies showed that a sample of this size not only would be feasible to recruit but would be sufficient to identify clusters that were statistically significantly different (e.g., Muñoz Sastre et al., 2023). A total of 400 lay people were contacted: 49% agreed to participate. In addition, six physicians – three cardiologists and three general practitioners – agreed to participate, as experts, in the study; their average age was 56.

2.2. Material

The material consisted of 32 vignettes asking the participant to imagine being a person who wakes up in the morning and does not feel well. The set of vignettes was obtained by crossing orthogonally the levels of four factors: (a) Pain: the nature of pain felt (chest pain that lasted more than fifteen minutes, chest pain that lasted less than fifteen minutes, back pain that lasted more than fifteen minutes, and no chest or back pain); (b) Nausea: the presence or absence of terrible nausea; (c) Sweating: the presence or absence of sweating, and (d) Breathing and weakness: difficulty breathing and a feeling of weakness or not.

A first example of the scenario is as follows: "It is nine o'clock in the morning. You are experiencing an intense pain in your chest, pain that extends to your left arm and has lasted for more than a quarter of an hour. You feel a tight, squeezing sensation in your chest. You feel terrible nausea. You are sweating. You feel weak and out of breath. Do you think you are having a heart attack?" A second example, with different factor levels is as follows: "It's nine o'clock in the morning. You feel a sharp pain in your back that has been going on for over a quarter of an hour. The pain seems to radiate down your arms and neck. You don't feel particularly nauseous. You're not particularly sweaty. Your breathing seems normal and you don't feel weak". The response scale was an 11-point scale ranging from "Definitely not" (0) on the left and "Definitely yes" (10) on the right.

2.3. Procedure

Each volunteer was tested on an individual basis, in a quiet room, immediately after agreeing to participate. Based on the participant's preference, the interview took place either in the participant's home (in most cases) or in an open classroom at the university. The process followed Anderson's (2008) guidelines for this type of study, see also Kpanake et al., (2014) and Muñoz Sastre et al. (2012). The sequence of presentation of the 32 vignettes differed between participants and was determined randomly. Participants took 25 to 35 min to complete the assessments. No one complained about the number of vignettes or the plausibility of the cases. The participants then answered the demographic questions listed in Table 1. The same procedure was used with the experts, who also worked individually. Ethical approval for the study was granted by the Institutional Review Board of the University of Toulouse. All participants signed an informed consent form before completing this survey, and responses were anonymous. The survey is on file in the Psychology Department of the University of Toulouse.

2.4. Statistical analysis

A cluster analysis was performed on the main sample's raw data using the K-means method advocated by Hofmans and Mullet (2013). A four-cluster solution was retained because it produced the most interpretable findings. An analysis of variance was then performed on the

Table 1
Demographic Characteristics of the Sample. Composition of the Clusters.

Variable	Level	Cluster Never Probable N (%)	Hesitant N (%)	Almost Correct N (%)	Chest Pain Only N (%)	Total
Gender	Male	8(9)	9(10)	48(52)	26(29)	91
	Female	6(6)	19(18)	56(55)	22(21)	103
Age	18–25 Years	4(6)	10(16)	38(59)	12(19)	64
	26–45 Years	6(9)	9(14)	30(46)	20(31)	65
	46 + Years	4(6)	9(14)	36(55)	16(25)	65
Education	Secondary	0(0)[a]	6(18)	19(56)	9(26)	34
	College	5(5)	18(19)[a]	49(50)	25(26)	97
	University	9(15)[a]	4(6)[a]	36(57)	14(22)	63
Heart Problems	No	12(7)	28(15)	94(53)	44(25)	178
	Yes	2(12)	0(0)	10(63)	4(25)	16
Know People	Yes	4(4)	17(18)	46(48)	29(30)	96
	No	10(10)	11(11)	58(59)	19(20)	98
Expertise	Lay People	13(8)	23(14)	86(53)	40(25)	162
	Nurse	1(3)	5(16)	18(56)	8(25)	32
Total		14(7)	28(14)	104(54)	48(25)	194

Values in parentheses are percentages calculated across each row. Know People = Know people who have had a heart attack. Values with the same superscript are statistically different, $p < .05$.

main sample's raw data, using a Cluster × Pain × Nausea × Sweating × Breathing, 4 × 4 × 2 × 2 × 2 design. As the cluster effect and all the interactions involving the cluster factor were significant at $p < .001$, subsequent analyses were performed at the cluster level.

3. Results

Fig. 1 shows the mean ratings given by the six experts. None of them considered any of the scenarios to be implausible. Median correlation between their ratings was 0.80. Ratings were much higher when pain was present in the scenarios ($M = 8.98$ for long term chest pain, $M = 8.90$ for long term back pain, $M = 8.33$ for short term chest pain) than when pain was absent ($M = 2.96$), $p < .001$. Ratings were higher when difficulty breathing was present in the scenarios ($M = 8.06$) than when it was absent ($M = 6.52$), $p < .03$. The effect of the breathing factor was, however, stronger when there were no pain symptoms ($4.67 - 1.25 = 3.42$) than when there were ($9.19 - 8.28 = 0.91$), $p < .05$. Finally, ratings were higher when nausea was present ($M = 7.82$) than when it was absent ($M = 6.76$), $p < .03$.

Fig. 2 shows the decrease in the average distance from the centroid as a function of the number of clusters considered. The four-cluster solution was the one that seemed optimal. It partitioned the sample into four groups of 14, 28, 104 and 48 participants. The first cluster ($N = 14$, 7%) was called *Never probable* because all ratings were low ($M = 1.43$). The other clusters are shown in Fig. 3.

The second cluster ($N = 28$, 14%) was called *Hesitant*. Ratings were higher than in the first cluster ($M = 2.61$) but far from being close to those of the experts. As can be observed in Fig. 3 (top panels), ratings were higher when long-lasting chest pain was present ($M = 3.90$) rather than absent ($M = 0.83$), $\eta_p^2 = .74$; when nausea was present ($M = 3.18$)

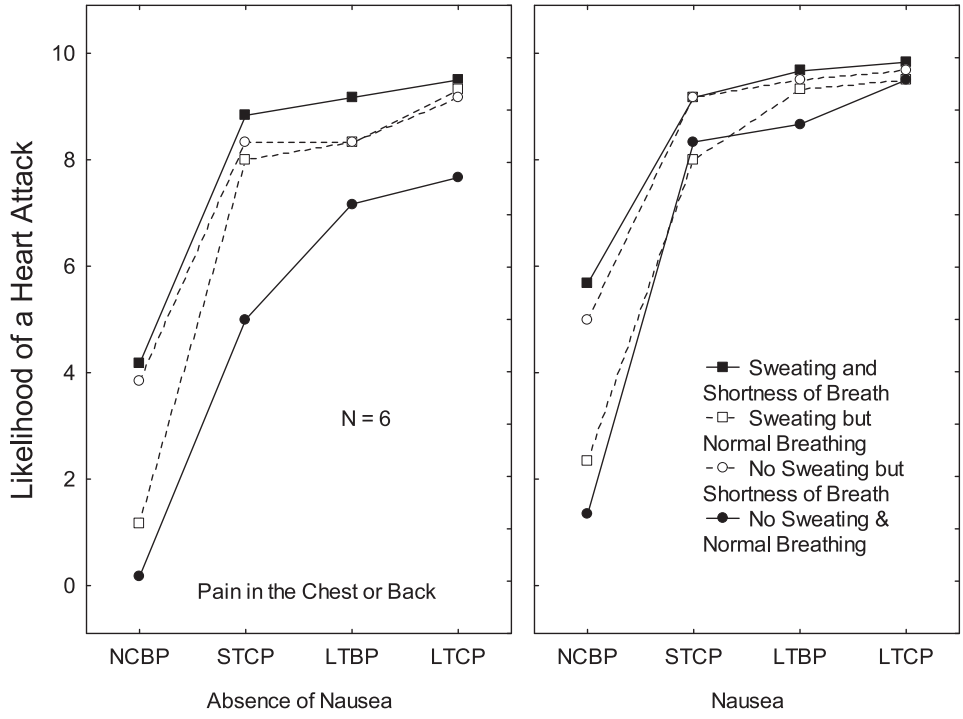

Fig. 1. The six experts' mean ratings. *Note*. The pain factor is on the horizontal axis (NCBP = Neither chest nor back pain, STCP = Short term chest pain, LTBP = Long term back pain, LTCP = Long term chest pain). The fours curves represent combinations of the levels of the respiration factor and of the sweating factor. Each panel correspond to one level of nausea.

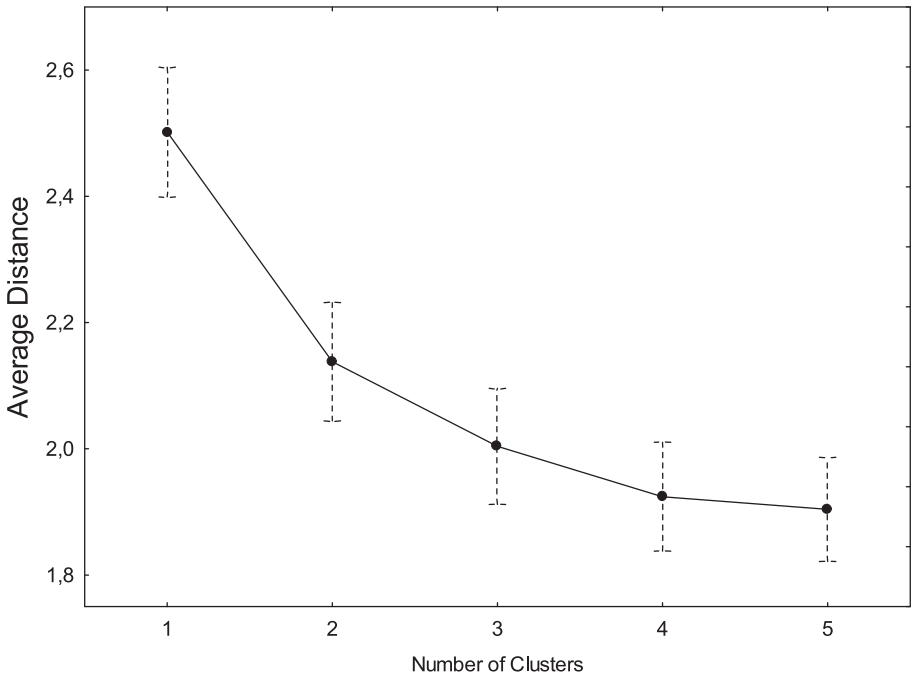

Fig. 2. Decrease in the average distance from the centroid as a function of the number of clusters considered.

rather than absent (M = 2.02), η_p^2 =.54; when excessive sweating was present (M = 3.09) rather than absent (M = 2.13), η_p^2 =.78; and when breathing problems were present (M = 3.40) rather than absent (M = 1.82), η_p^2 =.73. In addition, the effect of the pain factor was stronger when nausea was present than when it was absent, η_p^2 =.15.

The third cluster, the majority one (N = 104, 54%), was called *Almost correct*. As can be observed in Fig. 3 (center panels), the pattern of ratings was similar to that of the experts in Fig. 1. Ratings were considerably higher when long-lasting chest pain was present (M = 7.52) rather than absent (M = 2.05), η_p^2 =.76; when nausea were present (M = 5.53) rather than absent (M = 4.79), η_p^2 =.51; when excessive sweating was present (M = 5.56) rather than absent (M = 4.75), η_p^2 =.58; and when breathing problems were present (M = 5.93) rather than absent (M = 4.38), η_p^2 =.62.

The fourth cluster (N = 48, 25%) was called *Chest pain only* because, as can be seen in Fig. 3 (bottom panels), when pain was not located in the chest, ratings were lower (M = 2.20) than when it was located in the chest, whether it was long-lasting (M = 7.71) or not (M = 4.60), η_p^2 =.85. In addition, ratings were higher when nausea was present (M = 4.09) rather than absent (M = 3.56), η_p^2 =.36; when excessive sweating was present (M = 4.17) rather than absent (M = 3.48), η_p^2 =.56; and when breathing problems were present (M = 4.32) rather than absent (M = 3.32), η_p^2 =.47.

As can been observed in Table 1, among the demographic characteristics, only the level of education had a statistically significant effect on cluster membership. Those with a university education were more likely than those with less education to be in the *Never probable* cluster and less likely in the *Hesitant* cluster (although the combined percentages in the two clusters were similar at all educational levels). The age of the participant, however, had no impact on cluster membership. The nurses did not differ from the other participants.

4. Discussion

The four qualitatively different reactions among non-experts that were expected on the basis of previous works were found (Cytryn et al., 2009; Hwang & Jeong, 2012; Ratner et al., 2006). The majority reaction (54%) – the "Almost correct" cluster – was quite appropriate to the situation; it was very close to the average reaction of experts in the field. It consists of suspecting a heart attack as soon as intense pain occurs in the chest or back. If this pain stops after a certain period, the possibility of an attack is judged lower but not completely discarded. Other distressing manifestations (nausea, excessive sweating, and difficulty breathing) are seen as adding to the likelihood of having a heart attack, and the weights attributed to them are similar to those observed among the experts. The effect of each of these distressing manifestations is simply added to that of pain to produce an overall judgment of the probability of a heart attack. This finding is consistent with the results of most previous studies in Western countries showing that a significant proportion of people associate chest or back pain with heart attack (Birnbach et al., 2020).

The second reaction that was found (25%) – the "Chest pain only" cluster – was less appropriate to the situation. It retained from the first reaction only the idea that a heart attack should be suspected if the intense pain is localized to the chest and that if the pain stops, the possibility of an attack should not be ruled out. The contributions of the other factors to the overall judgment were minor. This finding is also consistent with results from previous studies showing that a substantial minority of people fail to realize that localized back pain can also, especially in women, be a symptom of a heart attack (Birnbach et al., 2020; van Oosterhout et al., 2020).

The third reaction (14%) – the "Hesitant" cluster – reflected the uncertainty of people in the face of disturbing manifestations that are difficult to interpret. Only in the presence of a combination of distressing conditions – pain, nausea, sweating, and shortness of breath – is a heart attack considered very likely. A similar reaction was described in the qualitative study by Hwang and Jeong (2012). The more educated were less likely to be uncertain than the less educated (6% vs. 19%).

Finally, the participants who expressed the fourth reaction (7%)—the "Never probable" cluster—may have been unaware of the symptoms of a heart attack (Ratner et al., 2006); may have known about heart disease but, given their age and health, considered themselves at very low risk (consistent with the membership in this group of 15% of those with university education vs. 0% of those with only secondary school education; and/or may have been affected by optimism bias, which, as pointed out by Weinstein (1988), is common.

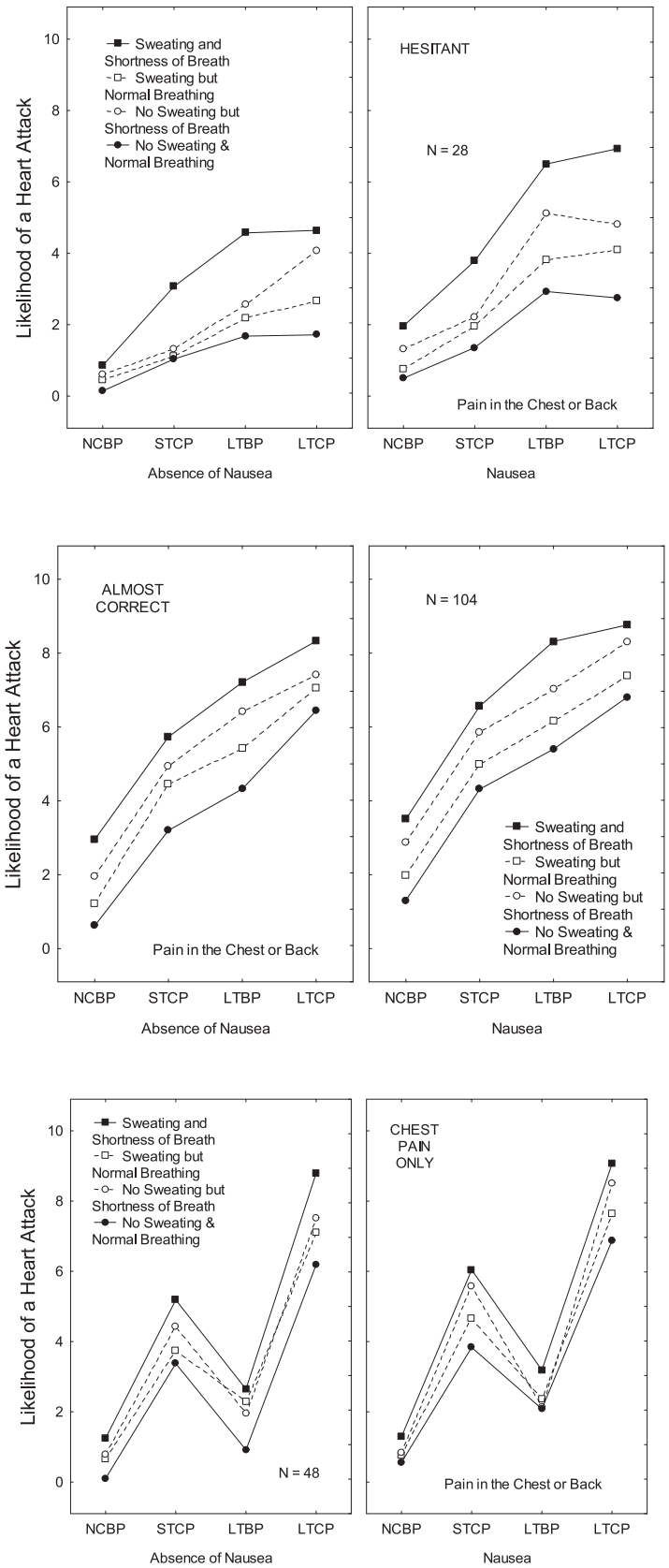

Fig. 3. The mean ratings of three of the four clusters of participants. *Note.* The pain factor is on the horizontal axis (NCBP = Neither chest nor back pain, STCP = Short term chest pain, LTBP = Long term back pain, LTCP = Long term chest pain). The fours curves represent combinations of the levels of the respiration factor and of the sweating factor. Each panel correspond to one level of nausea. Each row corresponds to one reaction (Hesitant, Almost correct, and Chest pain only).

4.1. Limitations

The first limitation of this survey is that it was a convenience sample of professionals and lay persons living in one region of France who agreed to complete a time-consuming judgment task. The second limitation is the young age of most participants. Two-thirds were 18 to 45 years old and, therefore, unlikely to feel at risk of suffering a heart attack. Yet, as shown in Table 1, none of the demographic factors affecting the risk of heart disease, the manifestations of heart disease, and the perception of risk—age, male vs. female sex, and the known presence of heart problems–had an impact on the likelihood of membership in a cluster. Nonetheless, future studies should analyze the reactions of representative samples of older people, those most directly affected by heart attack problems. The third limitation is the small number of manifestations that could be studied. An orthogonal design requires a multiplicative increase in the number of scenarios as more symptoms—including, for example, the separation of shortness of breath and weakness—are considered. Such an increase quickly becomes too burdensome for the participants. Although further studies could involve a different set of symptoms, the focus of this study on different aspects of pain is in accord with the medical literature.

5. Conclusions

In order for people to make the right decision when they experience unpleasant physical manifestations, it is not enough for them to be able to associate the individual manifestations with a given disease. They must also be able to consider them as a whole, i.e., to integrate the information from each manifestation – as a possible symptom of a disease –into an overall warning judgment that can lead to a prompt decision. In the current study, just over half of the participants appeared able to do this adequately. Their judgment processes were very much like those of the experts. They gave similar relative values to the different types of pain and similar weights to the other symptoms; for example, like the experts, they gave higher diagnostic value to persistent pain than to pain that had stopped, and they gave more weight to pain than to nausea. Like the experts, they used an additive-type judgment rule when integrating the pieces of information; none of the information was minimized or discounted when judging the likelihood of a heart attack.

The judgments of the other half of the participants, however, were more problematic. In particular, a quarter of them did not realize that a heart attack can manifest as back as well as chest pain, and the other participants either did not give sufficient weight to the various manifestations of a potential heart attack or simply downplayed its possibility. These individuals could benefit from judgment training programs in which (a) realistic situations of the type used here are presented, (b) a judgment of the likelihood of a heart attack is asked each time, and then (c) informative feedback is provided (cognitive feedback).

In a judgment training session, the person wishing to learn how to integrate information about various physical manifestations is presented with a scenario like the ones used here. The person makes an estimation by placing a mark along a response scale ranging from *Definitely not* to *Definitely yes*. Feedback is then provided in the form of another mark along the same response scale. This mark – the feedback – expresses, for example, the average judgment of a sample of cardiologists who responded to the same scenario. The person takes the time to compare the two responses. Then another scenario is presented to him/her. The person makes an estimate, feedback is presented, and the person observes the difference between the two responses. This continues until the pattern produced by the person's responses is sufficiently close to the pattern provided by the experts placed in the same situation.

Evidence suggests that this intervention could be implemented in the offices of primary care providers and specialists, and focus, at least at first, on those at greatest risk (Bonnin-Scaon et al., 2002; Mullet, 2011). It would help people to learn not only which elements of information are relevant to an important medical issue but also how to value them, how to weight them, and how to combine them mentally to produce estimates of risk close to those that experts would make. Patients could thereby learn how to recognize the onset of a critical medical problem, such as a heart attack, before it is too late.

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CRediT authorship contribution statement

Nicole Cantisano: Conceptualization, Investigation, Supervision, Writing – original draft. **Lamiae Ettayea:** Conceptualization, Investigation, Writing – original draft. **Emeline Frolleau:** Conceptualization, Investigation, Writing – original draft. **Sri Herath:** Conceptualization, Investigation, Writing – original draft. **Lonzozou Kpanake:** Conceptualization, Investigation, Methodology, Writing – review & editing, Funding acquisition. **María Teresa Muñoz Sastre:** Conceptualization, Investigation, Supervision, Methodology, Writing – review & editing, Funding acquisition. **Paul Clay Sorum:** Conceptualization, Investigation, Methodology, Writing – review & editing. **Etienne Mullet:** Conceptualization, Investigation, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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