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## EDITORIAL ARTICLE

## BELIEFS, EMOTIONS, BEHAVIORS &amp; CARDIOVASCULAR DISEASE RISK

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Cardiovascular diseases (CVDs) are the primary cause of death around the world (17.9 million deaths per year); heart attack and stroke account for 85% of CVD deaths<sup>1</sup>. According to current demographic data, 1/3 of these deaths occur in adults under the age of 70 and more than 75% in low- and middle-income countries.<sup>1</sup> Recent studies have provided clear evidence that psychological factors (e.g., depression, anxiety, personality traits, social isolation, and chronic life stress) have a key role in the pathogenesis and manifestation of cardiovascular disease because they affect platelet function, plasminogen activator inhibitor and fibrinogen, inflammatory cytokines, serotonin transporter (SERT) and endothelial function.<sup>2,3</sup> Therefore, pathophysiological mechanisms underlie the relationship between these entities and CVD, whereas alongside psychological conditions contribute to a higher frequency of adverse health behaviors, such as malnutrition, smoking and sedentary lifestyle.<sup>2</sup>

Beliefs are crucial in understanding human emotions and emotional disturbances and behaviors. In 1955, Rational Emotive Behavior Therapy (REBT) was developed by clinical psychologist Albert Ellis (1913-2007) as an integrative practical application of a variety of philosophical theories, according to which emotional and other types of mental health disturbances are caused not by an event, but by rigid and extremely negative beliefs about this event.<sup>4</sup> Ellis classified beliefs into two types: rational and irrational beliefs<sup>5</sup>. According to the ABC model of the REBT theory, there are an actual or an inferred activating event (A), rational or irrational beliefs about this event (B), and emotional, behavioral and cognitive consequences of these beliefs (C).<sup>5</sup>

Among the irrational beliefs that people persistently follow throughout their lifetime and influence their decisions are: a) "it is essential to be loved and approved by others", b) "experiencing disappointments in life should be avoided", and c) "someone is worthy when they pursue perfection". In addition to Ellis, the prominent psychiatrist Aaron Beck (1921-2021), the Father of the Cognitive Therapy (CT), believed that negative life events activate a cognitive triad of irrational beliefs: negative self-beliefs ("I'm not good enough."), the world ("This is a terrible place."), and the future ("Something bad will always happen.") that also produces and perpetuates many disorders.<sup>5</sup> Irrational beliefs, according to Dryden (2002), are linked to various dysfunctional behaviors including withdrawal from reinforcement, physical or verbal attacks on others, isolation, avoidance of stressful situations, self-harm, termination of communication, seeking of constant reassurance, disclaimer of responsibility, etc.<sup>6</sup>

However, this vicious circle of negative emotions and behaviors incited by irrational beliefs can be terminated if these beliefs are accurately identified via clinical interviewing techniques, through psychotherapy, as well as self-report clinical and

research measures. Bridges & Harnish (2010) have mentioned 25 scales and techniques that assess irrational beliefs according to Ellis and Beck's theoretical approaches<sup>5</sup>. Unfortunately, although irrational beliefs are a significant conceptual theme in psychotherapy through which maladaptive thinking patterns are addressed, challenged, and restricted into more adaptive emotional and behavioral responses, most studies have overlooked them, regarding their significance in dysfunctional behaviors, and chronic illnesses like cardiovascular diseases.<sup>7,8</sup>

Most studies are primarily focused directly on mental health issues such as anxiety and depression. For more than 30 years, depression, which is characterized by depressed mood and anhedonia, as well as other symptoms such as negative cognition, anergia, appetite disturbance, etc., has been significantly associated with the incidence of cardiac events in most studies.<sup>2</sup> Hopelessness is one of the dimensions of depression that received attention for its association with sudden death and the development of CVD<sup>2</sup>. A related dimension called "vital exhaustion" characterized by fatigue, irritability, exhaustion and demoralized emotions predicts CVD and cardiac events in healthy and CVD populations.<sup>2</sup> In contrast, the evidence linking anxiety to CVD is contradictory, although data suggest a significant relationship between anxiety disorders and cardiac death.<sup>2</sup>

Nonetheless, there is some limited research conducted on irrational beliefs but it has yielded significant findings. Preliminary findings showed that irrational beliefs are positively associated with 10-year CVD risk in both men and women, and they are prominent among those with lower education status, fewer healthy dietary habits, and high anxiety and depression levels.<sup>9</sup> Moreover, irrational beliefs accompanied by anxiety or depression are apparent in smokers and individuals who are less physically active, with lower adherence to the Mediterranean diet, obesity and hypertension. In terms of education, higher educational level is linked to lower levels of irrational beliefs, and in conjunction is linked to a lower risk of cardiovascular disease.<sup>9</sup> Regarding eating habits in Vassou et al (2021) study, irrational beliefs accompanied by anxiety or depression are important prognostic factors of adherence to the Mediterranean diet.<sup>10</sup> Besides, a Western-type dietary pattern is more apparent in people with high irrational beliefs levels and anxiety or depressive symptomatology, while diets high in refined carbohydrates and fats are the most dominant dietary style for individuals with irrational beliefs but without psychopathology.<sup>10</sup> Concerning biochemical mechanisms that could underlie the relationship between psychological aspects and cardiovascular disease risk, Papageorgiou et al. (2006) found that individuals who score highly on irrational thinking exhibit elevated plasma levels of C-reactive protein, interleukin-6, tumor necrosis factor- $\alpha$  and white blood cell counts compared to people who score lower on irrational thinking.<sup>11</sup> Similar findings derive from Vassou et al. (2021) study, in which individuals with high irrational beliefs and symptoms of anxiety or depression are at a greater risk of developing diabetes over a 10-year follow-up period, while lower education status, high BMI, as well as tumor necrosis factor and total antioxidant capacity, are mediating risk factors.<sup>12</sup> Moreover, (unpublished) data on CVD reveal that people with high irrational beliefs and anxiety or depression symptoms have a larger risk of developing CVD during a 10-year period, as compared to those without anxiety or depression, while C-reactive protein, interleukin-6, total antioxidant capacity and oxidized LDL-C are mediators in the tested associations.<sup>3</sup>

It has been long accepted that multifactorial mechanisms link psychological factors to increased cardiac risk. Based on the

holistic approach introduced by the biopsychosocial model of health and illness, we suggest that biological (e.g., sympathetic and hypothalamic-pituitary activation, endothelial dysfunction, platelet activation, proinflammatory cytokines, and atherosclerosis) psychological (irrational beliefs, anxiety, depression) and social factors (age, educational status) interact and produce chronic illness like cardiovascular disease. Starting from the social factors, like educational status, there is a substantial connection between socioeconomically disadvantaged classes, irrational beliefs, and adverse health outcomes, such as cardiovascular disease. One explanation is that people with low socioeconomic status are more prone to develop emotional disorders, including chronic stress, anxiety, depression, as well as negative behavioral reactions (e.g., malnutrition, excessive smoking and physical inactivity), as a result of financial distress, job insecurity, stigma and low income<sup>9</sup>. Inadequate education provides less access to knowledge and information and impaired critical thinking skills.<sup>9</sup> Hence, less educated individuals are more likely to adopt fewer rational ideas and therefore, to make fewer healthier choices (e.g., smoking overconsumption and physical inactivity) due to the lack of appropriate health information.<sup>9</sup>

Additionally, irrational beliefs except for their contribution to the likelihood of negative and unpleasant emotions, such as aggression, loneliness, anxiety and depression, become antecedents of adverse lifestyle behaviors as coping strategies (e.g., unhealthy diet, sedentary lifestyle, etc.). Anxiety, in particular, increases appetite and leads to a craving for high-fat and sugary meals, or overeating as a coping strategy to distract from unpleasant and stressful events.<sup>10</sup> Individuals with anxiety or depression experience excessive craving and hyperconsume carbohydrates due to an increase in brain serotonin synthesis.<sup>10</sup> The "Western" diet increases the risk of mental health problems, including depression, while following a Mediterranean and lacto-vegetarian diet is linked to a decreased risk of depression and other mental health difficulties.<sup>10</sup> In addition, nutrients are necessary for brain function as they regulate chemical processes (e.g., metabolic pathways, neurotransmitter synthesis, cell-cell signaling).<sup>10</sup> Numerous biochemical mechanisms explain the connection between nutrition and mental health, including inflammation, oxidative stress and hippocampus. Particularly, a Western dietary pattern can result in higher amounts of circulating plasma A $\beta$  that may lead to hippocampal dysfunction, while a high-sugar, high-fat diet may also impair hippocampal function.<sup>10</sup> On the contrary, a healthy diet and omega-3PUFA may boost cognitive function and reduce oxidative stress.<sup>10</sup>

The combined effects of irrational beliefs system, anxiety and depression as well as specific socio-economic and lifestyle factors may induce inflammation and oxidative stress as an underlying biochemical process in the abnormal activity of the nervous system (e.g., sympathetic over-activity vs. vagal dysfunction) and the hypothalamic-pituitary-adrenal axis (HPA) which contributes to the development of cardiac events.<sup>3</sup> The sympathetic nervous system is constantly stimulated at the expense of the parasympathetic nervous system, under those circumstances, resulting in increased levels of pro-inflammatory cytokines. Emotional disturbances are involved in the abnormal activity of the autonomic nervous system and the HPA axis affecting the cardiovascular system.<sup>3</sup> Alongside, emotional problems are associated with a reduction in vagal nerve activity and total heart rate variability.<sup>3</sup> Increased vagal activity (i.e., vagal tone) regulates heart rate, protects coronary vascular cells and reduces peripheral vascular inflammation when combined with acetylcholine.<sup>3</sup> Consequently, reduced vagal nerve activity is likely to lower myocardial infarction tolerance and exacerbate cardiovascular dysfunction.<sup>3</sup>

To conclude, irrational beliefs could be considered as the beginning of emotional difficulties that are primarily associated with future cardiovascular diseases, as evidenced by the theoretical framework and the research conducted so far. For this reason, this article emphasizes the importance of early detection of irrational beliefs, given that necessary tools and clinical methods are available to predict and prevent potential mental disorders and problematic behaviors that may lead to future cardiovascular disease. However, relevant training from specialized psychologists to the medical and other specialized staff (such as doctors, nurses, nutritionists) will be needed in order for primary prevention to be implemented, and for specialists to immediately detect dysfunctional thinking and identify high-risk groups. Management and treatment of irrational beliefs should be carried out through appropriate psychotherapy, i.e., cognitive-behavioral interventions.

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