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FED STATE AND OBESITY
IN RELATION TO PAIN REACTION

by

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STATEMENT BY AUTHOR

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ABSTRACT

Endogenous opiates have been implicated in pain control and in obesity; the greater the degree of obesity, the higher the endogenous opiate levels. The primary hypothesis proposed was: the greater the degree of obesity, the less the reaction to pain.

The design of the study was descriptive utilizing a visual analogue scale to measure pain reaction, the pain stimulus being an intravenous venipuncture. This was correlated with the Body Mass Index (BMI) to determine degree of obesity. Subjects selected (n=15) were white females admitted to the hospital for acute medical or surgical problems.

Data analysis revealed no statistically significant values, however several trends emerged. A relationship appeared between all the variables; the higher the BMI, the longer the time since eating, and the lower the fed state and age, the less the reaction to pain. This relationship supported the theoretical framework, although more research is needed before it is utilized.

CHAPTER I

INTRODUCTION

There are two health problems today which are of epidemic proportions: obesity and pain. According to Edelstein (1980), obesity is the number one public health problem in the United States today. Interestingly enough, these two seemingly different problems may be intimately linked physiologically. The purpose of this research will be to demonstrate this link using a descriptive model. Specifically, this study will attempt to answer the following questions: Do obese subjects show less reaction to the pain of an intravenous (IV) start in relation to lean subjects? Do recently fed subjects show a greater reaction to pain due to an IV start than subjects that have been food deprived?

Delineation of Problem

In the most general form, there are three different types of pain: acute, chronic, and psychogenic. Acute pain is discomfort of relatively short duration that usually serves a useful purpose such as providing information on location and type of pathology or injury. Chronic pain is pain that lasts longer than six months and serves no useful purpose. Psychogenic pain is rare and is purely produced in the patient's mind. It is characterized by wide variations of pain in a variety of locations. With psychogenic pain, the patient is primarily concerned with proving the authenticity of the pain (Armstrong, 1980).

Pain has three components according to Weisenberg (1975). These components are: sensory (brainstem), emotional/motivational (intermediate/limbic), and cognitive (outer, more advanced) (Weisenberg. 1975). The sensory component is concerned with survival functions (Weisenberg, 1975). The emotional/motivational component is concerned with emotional and behavioral aspects of pain (Weisenberg, 1975). The cognitive component is more advanced and concerned with higher conscious functions (Weisenberg, 1975). All of the above components contribute to the totality of the pain experience, and the reduction of any one reduces this experience (Armstrong, 1980). Nursing interventions are mostly directed at reducing the emotional/motivational component (Armstrong, 1980).

Several concepts are used to describe pain and these are: threshold of pain, tolerance to pain, perception of pain, and reaction to pain (Armstrong, 1980). Threshold is defined as the beginning awareness of the presence of pain and is physiologically considered the same for all individuals. Tolerance is a point at which the pain can no longer be tolerated, and this varies from individual to individual. Perception is the physical sensation of pain (sensory component) and does not require conscious recognition on the part of the affected individual. Reaction is the psychological, motivational and cognitive response to pain which requires consciousness with involvement of the limbic system and cerebral cortex (Armstrong, 1980). Neufeld and Davidson (1975) showed that preparation for a threatening situation through prior knowledge reduces the pain experience. Relevant prior experience identical to the pain stimulus resulted in a significant increase in pain tolerance (Neufeld and Davidson, 1975). This indicates the importance of the cerebral cortex in pain perception.

Pain Theories

In the past there have been several theories regarding pain and its perception. One that was popular until the 1930's was the Specificity theory. In this theory, it was thought that specific types of cutaneous receptors relayed information along specific nerve pathways to defined areas of the brain (Armstrong, 1980). Unfortunately, this theory did not explain phantom or referred pain.

The next theory to be developed was the Pattern theory. This theory stated that all types of cutaneous receptors were potentially interested in all forms of stimuli, and the interpretation of the stimuli was a function of the brain (Armstrong, 1980). Again, this theory failed to explain phantom and referred pain.

In 1965, Melzack and Wall combined the two above theories into the Gate Control theory. This theory states that increased activity of large, myelinated fibers (A fibers) has the potential to inhibit pain-related information traveling along smaller, unmyelinated sensory fibers (C fibers) (Melzack and Wall, 1965). A gating mechanism was proposed through which the larger fibers could eliminate the sensation of pain being transmitted by the smaller fibers (Melzack and Wall, 1965). The location of the gate is the substantia gelatinosa in the dorsal horn of the spinal cord (Melzack and Wall, 1965). The substantia gelatinosa (SG) functions by modulating the afferent patterns before they influence the T cells, which are the central transmission cells (Melzack and Wall, 1965). Afferent patterns act as central control triggers that influence the gate modulating system, and the T cells are responsible for activating the neural mechanisms for the action system of response and perception (Melzack and Wall, 1965). The small fibers are tonically active, adapt slowly, and therefore constantly barrage the spinal cord with stimuli, and hold the gate open; the larger fibers are less active but have the ability when stimulated to effect not only the T cells, but the SG as well, which presynaptically inhibits stimulation of the T cells by both the large and small fibers (Melzack and Wall, 1965).

Pain Physiology

Basically there are two types of fibers that carry pain information, A fibers, which are large and myelinated and carry sharp, localized pain and touch; and C fibers which are small and unmyelinated and carry dull diffuse pain along with sympathetic impulses (Goodman, 1983). Pain fibers pass from the dorsal root ganglia and enter the spinal cord via the dorsal root where they synapse with dorsal horn neurons in a laminar or layered fashion primarily in the SG. Fibers ending in the hypothalamus and limbic system are responsible for the emotional component of pain, and interestingly, these areas are responsible for the descending inhibitory systems of pain regulation. Fibers that end in the ventrolateral funiculus (VLF) synapse in thalmic nuclei to project to the cortex for the conscious recognition of pain (Goodman, 1983).

In the cerebral cortex, there exists an area in the midbrain which appears to be the pain center of the body. This area is the periaquiductal gray (PAG) area of the midbrain. Stimulation of the PAG produces suppression of pain in animals (Fields, 1984). An electrical signal is received in the PAG as a spike potential with a nonuniform spacing or frequency which is interpreted as pain; the cerebral cortex does not convert the spike potentials into specific sensations (Emmers, 1981). This type of physiological signal is the basis for biofeedback, and transcutaneous nerve stimulation (TNS) as treatment for pain. According to this spike potential theory, the nocioceptive system does not need to be silenced, but rather the critical intervals changed, and for this purpose, excitation is as effective as inhibition (Emmers, 1981).

The next level of the central nervous system involved in pain is the spinal cord. An intact spinal cord is necessary for the system to work. According to Fields (1984), the analgesic effect of the PAG stimulation and low systemic doses of morphine were almost completely blocked by lesions in the dorsolateral funiculus (DCF) of the spinal cord. Thus, a brainstem to spinal cord connection via the DCF contributes significantly to the analgesic effect of systemic morphine. A variety of cells in the rostroventral medulla (RVM), perhaps activated by endogenous opiates or PAG stimulation, project to the spinal cord and stimulate an interneuron that inhibits the primary afferent (presynaptic) and/or the central pain transmission neuron (Fields, 1984).

Endogenous opiates also seem to play an important role in pain modulation. Beta-endorphin is found in increased concentration in the cerebrospinal fluid after treatments for pain such as acupuncture and TNS (Goodman, 1983). Another endogenous opiate is enkephalin, which is thought to modulate the release of substance P, which is the messenger of nocioception. Although substance P is the primary neurotransmitter, there may be as many as 200 other neurotransmitters involved in pain transmission and inhibition, of which only two dozen are known (Goodman, 1983). Substance P transmits pain information via pain fibers in the dorsal horn, and is also present in the intestines, brain stem, and both sensory and nonsensory pathways (Armstrong, 1980). It is interesting that at high doses substance P excites pain fibers, but stimulates the release of endorphins at very low doses (Armstrong, 1980; Frederickson, et al. 1978). This is similar in action to low doses of naloxone (Armstrong, 1980). It is believed, however, that enkephalins and substance P play opposing roles in the regulation of pain transmission through neural pathways (Frederickson, et al. 1978).

Enkephalins are short-chained peptides with short duration of activity found throughout the central and peripheral nervous systems as well as the intestines (Armstrong, 1980). Endorphins are long-chained peptides with longer lasting activity and are found in the hypothalamus-pituitary axis, thalamus, midbrain, pons, and circulating throughout the body (Armstrong, 1980). These are released when pain is anticipated or experienced, and appear to act by occupying receptor sites at the synapse decreasing the passage of pain information between neurons (Armstrong, 1980). Endorphins are abundant in areas of pain anatomy such as the dorsal horn, brain stem, and limbic structures (Armstrong, 1980). Fields (1984), believes that opiates produce analgesia in part by activation of a pain modulating system rather than by direct inhibition of the pain transmission neuron. Armstrong (1980) believes that these endogenous opiates may act by reducing the emotional/motivational component of the pain experience. The activity of these endogenous opiates is reduced by naloxone (Armstrong, 1980).

Obesity and Endogenous Opiates: Autoaddiction Hypothesis

Interestingly enough, enkephalin has been implicated in the regulation of food intake. Enkephalin is as addicting as morphine, occupies the same sites, and has been connected most recently to pain control (McCloy and McCloy, 1980). Enkephalin is found in the highest concentrations in the stomach antrum, and duodenum in open-ended secretory cells that sample stomach contents at the open end, and releases enkephalin as a local hormone at the other end (McCloy and McCloy, 1980). McCloy and McCloy (1980) believe that enkephalin released by the secretory cells inhibits nearby afferent enkephalinergic neurons to switch off feeding and hunger drive in the brain. The strength of the stimulus is determined by the number of cells recruited by the influx of food into the stomach and intestine (McCloy and McCloy, 1980). These authors believe that obesity is influenced by autoaddiction to the circulating enkephalin. This is called the Autoaddiction Hypothesis (McCloy and McCloy, 1980).

Opiates act by inhibiting cyclic AMP (C-AMP) and hence the activity of neurons (McCloy and McCloy, 1980). Continued inhibition leads to an increase in the capacity of the neuron to produce C-AMP, so higher levels of opiates are necessary to switch off the neuron (McCloy and McCloy, 1980). This is known as tolerance (McCloy and McCloy, 1980). One can see that if the receptor-secretory cells in the duodenum overproduce and release too much enkephalin, or if it is not degraded rapidly enough, then the excess of enkephalin over and above the amount required to reduce the activity of the receptor neuron will have the same effect as circulating morphine (McCloy and McCloy, 1980). Repeated regular excesses will soon cease to satisfy and dependence and tolerance develops (McCloy and McCloy, 1980). Some neurons cannot now be switched off, and the satiety mechanism fails to an extent; the consequence of which is overeating (McCloy and McCloy, 1980). The short half life of enkephalin causes rapid disappearance of the enkephalin from the receptor neuron which causes excessive activity in dependent neurons and constitutes a withdrawal syndrome before the next meal is due (McCloy and McCloy, 1980).

Unfortunately for this Autoaddiction theory, animal and human experiments have shown that morphine and enkephalin actually stimulate feeding rather than inhibit it. Given, et al. (1980) discovered that circulating beta endorphin and beta lipotropin levels were elevated significantly above the levels of nonobese controls and that the degree of elevation was correlated with body weight suggesting a correlation between obesity and endogenous opiates. Atkinson (1982) found that systemic administration of naloxone significantly reduced food intake in obese subjects compared to lean controls given the same dosage. This was not seen with lower dosages, and glucose and insulin levels did not change during the infusion in either group (Atkinson, 1982). Morley and Levine (1982) found that systemic administration of naloxone decreases feeding in food deprived animals, and that dynorphin (another endogenous opiate) is a potent inducer of feeding in sated rats. They suggest that enkephalins primary role is the initiation of the food drive with the analgesic effects only secondary (Morley and Levine, 1982). Naloxone injection has little effect in decreasing food intake in freely feeding animals, but has a marked effect in decreasing the food intake in food deprived animals (McKendall and Haier, 1983).

Pain Sensitivity and Obesity

It has been shown that the threshold for the nocioceptive flexion reflex was well correlated with pain sensation (Pradalier, et al., 1981). Pradalier, et al. (1981) showed that this threshold was significantly lower in obese subjects compared to lean subjects (human). Interestingly, naloxone injections did not produce a change in these parameters in either the controls or the obese subjects

(Pradalier, et al., 1981). These data are contrary to animal data, and there was no mention of psychological or fed state controls.

Zahorska-Markiewicz, et al. (1983) showed that obese subjects were significantly less pain sensitive than lean controls using similar clinical experiments to Pradalier's group. In different clinical experiments, these same researchers showed that obese individuals were not as susceptible to pain of the transcutaneous electrical stimulation; the hypothesis was that the decrease in pain tolerance was due to the increase in circulating endogenous opiates (Zahorska-Markiewicz, et al., 1983).

Pain and Its Relationship to Food Intake

It is interesting to note that none of the above studies indicated controls for food intake prior to the study. Logically, if one believes that endogenous opiates do indeed stimulate feeding, then a subject who has been without food for several hours should have a stronger stimulus to eat and therefore have higher circulating levels of endogenous opiates.

McGiven and Gray (1980) showed that diurnal fluctuations do not seem to have any effect on pain sensation in rats, but fluctuations were seen following food intake or deprivation. Food deprivation produced a decrease in pain sensitivity, which was strongly attenuated by naloxone injection (McGiven and Gray, 1980). It has been proposed that food deprived animals may be acting under maximum opiate activity and thus would not show an increase in eating behavior with morphine injection, whereas freely feeding animals are functioning under minimal endorphin activity, and morphine would have a greater effect; this is indeed what occurs (McKendall and Haire, 1983). An extension to humans would suggest that endorphin activity of humans may also be related to current feeding state. Thus, a group unselected for food deprivation could be operating under a low level of endorphin activity which would result in lower pain tolerance, and insensitivity to naloxone (McKendall and Haier, 1983). Therefore it would seem prudent to select subjects in relation to their feeding state.

Study Purpose

As one can see, the state of the art is confusing at this point, however it has been shown that circulating endogenous opiate levels are elevated in obese subjects. It is from this point of view, given the pain reducing properties of endorphin, that the following questions emerge: Do obese subjects show less reaction to pain due to an IV start in relation to lean subjects? Do recently fed subjects show a greater reaction to pain due to an IV start than do food deprived subjects?

Significance

The stimulus most likely to bring a person to seek medical attention is pain. Since this is the most common reason for medical attention, it is important to study it from all aspects. In the acute care setting, it is the nurse who is responsible for monitoring the patient's reaction to pain, and is largely responsible for the control of pain.

Obesity is another common problem seen in the acute care setting. These patients require that special care be given because of their unique needs. It has been stated that obesity is the number one public health problem in developed countries today, and the number is growing. The percentage of males and females who were 20% or more overweight was higher in 1971-74 than in 1961-62 for the ages of 25 to 44 (Bray, 1979). Thus, nurses need to be aware of the problems and idiosyncracies of the obese patient. With the results of this study, nurses may be able to better plan the care for their obese and lean patients regarding pain control by having insight into their patient's physiological needs. It is possible that this information could serve as a screening tool for planning pain control.

Summary

There have been several theories that have attempted to explain pain, the most recent and useful is the Gate Control theory. In this theory, there are two types of pain fibers that transmit pain information. Stimulation of the larger of these two fibers inhibits excitation of the central pain transmission neurons, and thus reduces the pain experience. Endogenous opiates have been shown to be involved in pain modulation either by decreasing the passage of pain information between neurons, or by modulation of the release of substance P. These endogenous opiates have also been implicated in obesity, and have been shown to stimulate feeding. Additionally, the circulating levels of endogenous opiates have been shown to be elevated significantly in obese subjects when compared to lean subjects. Lastly, research indicates that endogenous opiate activity may be related to feeding state; those subjects who are food deprived have been shown to have higher circulating levels of endogenous opiates.

The purpose of this study is to discover whether obese subjects show a decreased pain reaction in relation to lean individuals. Additionally, it is hoped that a relationship between the time of the last food intake and pain reaction can be established; do recently fed subjects show an increase in pain reaction when compared to food deprived subjects?

CHAPTER II

CONCEPTUAL FRAMEWORK

Chapter two describes the concepts in the conceptual framework and their relationships. The conceptual framework proposed for this descriptive comparative study is shown in Figure 1.

Increased Levels of Endogenous Opiates

As has been described in detail in Chapter one, in obesity, one sees increased levels of endogenous opiates. Additionally, these opiates are influenced by fed state; the greater the length of time since the last meal, the higher the circulating levels of endogenous opiates. These opiates are thought to stimulate feeding. These opiates not only stimulate feeding, they influence the perception of pain. The higher the circulating levels of endogenous opiates, the less the pain.

As was stated earlier, obese subjects have been shown to be less pain sensitive than their lean counterparts. The hypothesis is that the decrease in pain tolerance is due to higher circulating levels of endogenous opiates (Zahorska-Markiewicz, et al., 1983). Morley and Levine (1982) believe that the analgesic effects of the endogenous opiates is only a secondary function with the primary role being initiation of the food drive. These authors believe that since animals may be forced to encounter danger in the quest for food, the

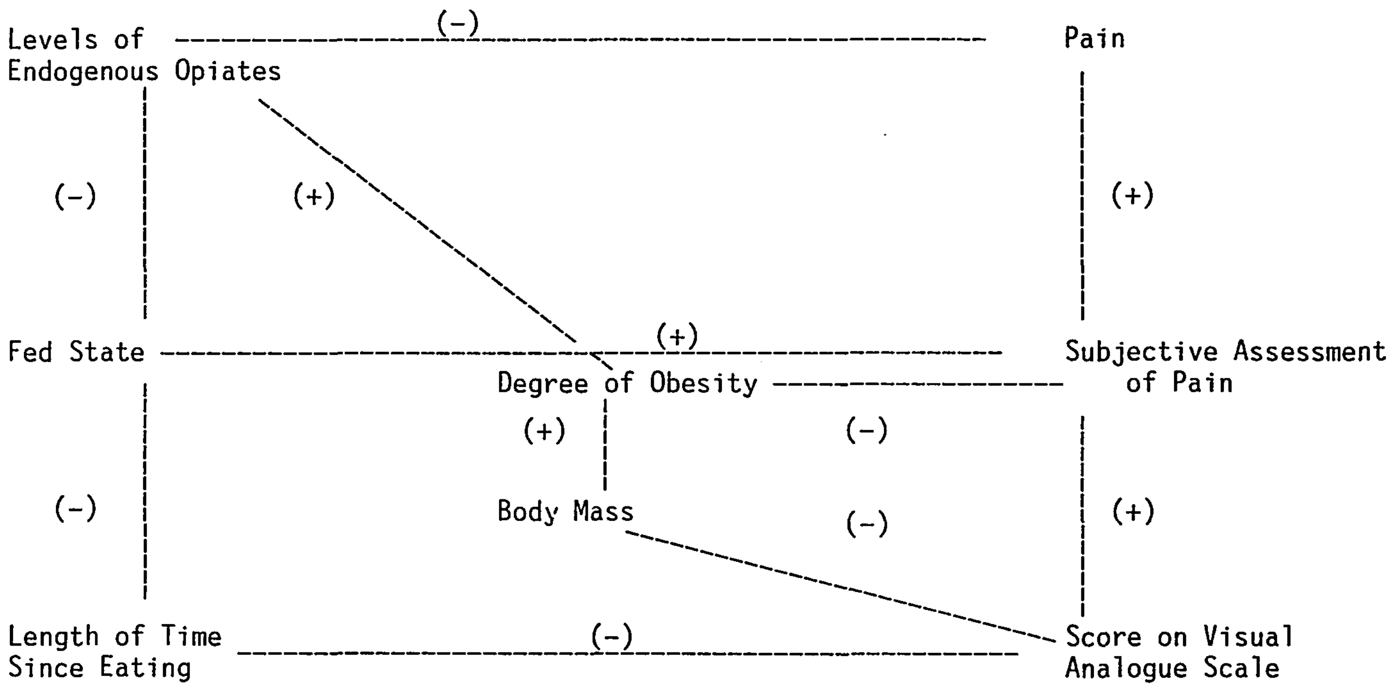

Figure 1. Conceptual Framework For Study

analgesic effect may be an adaptive side effect (Morley and Levine, 1982).

Degree of Obesity

Obesity has many definitions, most of which agree at some point or another. Bray (1979) defines obesity as a surplus of body fat, whereas overweight is defined as excess in body weight relative to standards for height. A statistical definition which has been used in population studies names those that fall in the upper 5-20% of the criterion being used, as obese (Sims, 1979). This criterion is usually based on life insurance tables, such as the Metropolitan Life Insurance tables (Bray, 1979). Also defined is super obese, or those that are 50-100% above ideal body weight (based on life insurance tables) (Sims, 1979). The problem with these tables is that they do not take frame size into account, but rather use a single value with an average range for a given height (such as the Fogarty tables) (Sims, 1979). Sims (1979) sees obesity as a continuum with no real cutoff points existing between slightly and grossly obese.

The Body Mass Index (BMI) has been shown to have the highest correlation with independent measures of body fat, such as triceps skin fold, and is a weight measure divided by a height measure (wt/ht squared) (Sims, 1979). Unfortunately it does not hold up in children and is recommended for use in subjects only over age 18 years (Sims, 1979). Bray (1979) believes that the BMI should be used as a method of relating weight variations to height, but more specific means should be used to assess body fat and its distribution. For purposes of this study, the BMI will be correlated with the score on the pain scale to determine the relationship between the pain reaction of lean and obese subjects.

Fed State

Fed state influences the levels of endogenous opiates, as was discussed earlier. The greater the length of time since the last food intake, the higher the circulating levels of endogenous opiates. McGiven and Gray (1980) showed that food deprivation produced a decrease in pain tolerance in rats which was strongly attenuated by naloxone injection. It is felt that these animals are acting under maximal opiate activity which decreases their perception of pain.

Fed state will be determined by asking subjects at what time they completed their last food intake, and recording it along with other demographic data. State of satiety will also be determined by asking for a subjective report of hunger from the subject. A "yes" on the question regarding hunger is equal to a low state of satiety and will be scored as a "1"; a "no" response indicates a high state of satiety, and will be scored as a "2".

Subjective Assessment of Pain

Pain is a very subjective experience, and is different for everyone. As was defined earlier, threshold of pain is basically the same for all individuals. The pain tolerance is what differs between individuals. Several other factors also confound the reaction to pain. Some of these variables are culture, age, sex, psychological state, and socioeconomic class. Hetherington (1969) showed that persons of lower economic class (including low prestige ethnic background, low economic class, and lack of occupational mobility) were insensitive to presenting symptoms. Ethridge (1972) showed that Mexican-American males had less physiological and psychological pain (as assessed by Petrie's Assessment of Pain Scale), less physiological pain as measured by the administration of fewer narcotics, and had less psychological anxiety than their Anglo counterparts with similar diagnoses. Woodrow, et al. (1975) showed that pain tolerance decreased with increasing age for both sexes.

Sex differences seem to play an important role in pain perception as well. The major problem with the sex differences is the traditional male and female roles, and how society dictates their actions. Goldberg (1976) believes that traditional male values have deliterious effects in the rehabilitation process and may be responsible for the higher mortality rate seen in males of all ages when compared to females of similar ages. Skord and Schumacher (1982) believe that male mortality rates are higher because males report less sickness because it is unmanly to be ill. Male dependence is not tolerated by society, and males find it harder to meet the requirements of the sick role (Skord and Schumacher, 1982). Notermans and Tophoff (1975) showed that in experimental pain situations, males tolerated more pain than women.

Beecher (1956) showed that the setting in which the pain is experienced can effect the reaction to pain more than the actual physical damage. Of 215 men who were seriously wounded in battle, only 25% required a narcotic for pain relief, whereas 80% of the civilian subjects wanted relief from a surgical wound produced under anesthesia (Beecher, 1956). This is attributed to the significance assigned to the wound rather than the actual physical damage. In battle, wounds meant that the soldier would be taken to safety, but the surgery done on the civilians meant disaster (Beecher, 1956).

Summary

Higher circulating levels of endogenous opiates reduce the pain experience either by direct action, or by modulation of neurotransmitters responsible for the passage of pain information. These circulating levels of endogenous opiates can be influenced by many factors, the most important of which seem to be fed state and degree of obesity. The longer the time since the last meal, the higher the circulating endorphins. Obese subjects have also been shown to have higher circulating levels of endogenous opiates. The pain experience is also influenced by sex of the patient, his psychological state, cultural background, surroundings and the meaning of pain. All of these factors must be taken into account for any accurate measure of pain reaction.

CHAPTER III

METHODOLOGY

Design

The research design for this study was descriptive. The reasoning behind this selection is that the connections between feeding state and endorphin secretion are unclear, and this precludes the use of an experimental study. Secondly, there is little work done in the area of pain reaction and its relationship to obesity, and the results of this work is contradictory.

Setting and Sample Selection

The settings chosen for data collection were adult medical/ surgical units in a general, community hospital. Intensive care units and other specialized areas were omitted for several reasons. A great number of those subjects found in intensive care units are intubated and disoriented. Additionally, too many stimuli may be acting on the subject for the subject to split the pain stimulus from the other stimuli.

Subjects were selected via a convenience sample. All subjects willing to participate and qualifying were included in the study. All subjects had an intact spinal cord, and spoke English. Additionally, all subjects were admitted for an acute problem, those admitted for exacerbations of a chronic problem were omitted. Height and weight were established after administration of the pain scale, to protect against experimenter bias. To protect against cultural and sex variables, only white females were selected. Given the effect of experience with pain, and the effect on its perception, those subjects with a history of hospitalization in the last six months were eliminated from the study.

In summary, the criteria for sample selection include: white females, English speaking, admitted for acute problem, intact spinal cord, admitted to a general medical/surgical ward and have no recent (within six months) hospital admissions.

Since obesity is considered a continuum, subjects were not divided into groups of lean and obese, but rather correlations were sought between the degree of obesity (or leanness) and the subjective report of pain.

Protection of Human Subjects

Informed consent was obtained by the use of a disclaimer at the beginning of the questionnaire. Additionally, approval for the study was obtained through the Human Subjects Committee at the University of Arizona Health Sciences Center and the College of Nursing. Subjects were advised of their rights and were allowed to ask any questions germane to the study that they felt appropriate prior to answering any of the questions. See Appendix A for Human Subjects Approval letter and a copy of the disclaimer.

Instrumentation

Pain Stimulus

The pain stimulus selected was an IV venipuncture. It was selected for several reasons: it is a procedure that is performed frequently by nurses, it is easy to perform and does not necessitate unnecessary painful procedures on subjects, and the pain stimulus is uniform and acute in duration. To protect further from experimenter bias, an IV nurse was used to administer the pain stimulus, rather than the experimenter. To protect against differences in technique, the same IV nurse was asked to start the IV on all subjects. The gauge needle was small, that is less than or equal to 20 guage, and the catheter was an over-the-needle type with a teflon catheter. The intravenous solution was a non-irritating type, thus high dosages of potassium (greater than 30 mEq per liter) and peripheral hyperalimentation were avoided. The data collection instrument was administered within five minutes of the venipuncture, and only those subjects in which the IV was started on the first try were selected. The patient's height and weight was measured by the researcher.

Subject Assessment of Pain

Since pain is a subjective experience, the instrument used to measure it should also be a subjective one (Woodforde, 1972). Of all the scales in use today, the Visual Analogue Scale (VAS) has been judged the most reliable (Ohnhaus and Alder, 1975). It requires the subject to transfer pain sensation into only one other dimension, rather than two or three as in most verbal rating scales (Ohnhaus and Alder, 1975). The VAS is preferred by patients because it is easy to use and is judged as more accurate in measuring pain and pain relief (Joyce et al. (1975).

The VAS is a simple tool which is a 10 centimeter line with two descriptive words at the extreme ends, such as "no pain" and "the most pain I could imagine". The end points of the scale should not be so extreme as never to be used, and it is not necessary to alternate favorable extremes of the line (Scott and Huskisson, 1976). The descriptive terms should be short, readily understood expressions in common use, and numbers should not be superimposed on the scale (Scott and Huskisson, 1976). Joyce et al. (1975) state that the labeling should correspond to the absolute minimum and the absolute maximum assessment that could ever be experienced in an attempt to anchor the ends of the scale verbally so that the intermediate points can be assessed nonverbally, and to decrease the opportunity for differing interpretations by patients.

The reliability of the VAS has been shown in tests for powerful pain relieving drugs. The VAS methods gave the most sensitive assays for the more powerful drug in tests for drug effectiveness (Joyce et al. 1975). In a test of 74 chronic inflammatory or degenerative joint disease patients, 32 preferred the VAS to the four point verbal scale feeling it was more accurate and sensitive giving better indication of the pain (Joyce et al., 1975). The 20 patients who chose the four point verbal scale did so because they felt it was easier, more definite, or needed less imagination, whereas those who chose the VAS did so because they felt it was more accurate, more sensitive, or that it gave better indication of the pain (Joyce et al., 1975). In other comparison of verbal rating scales (rating scale) and VAS, the rating scale was found to produce an artificial augmentation of drug effect because of the error associated in transfering the pain experience into a digital system; the VAS seemed to present the method which reflects more precisely what a patient actually feels than the rating scale (Ohnhaus and Alder, 1975). Linear regression lines of the correlation of the two rating methods showed the VAS to have much lower values than the rating scale (Ohnhaus and Alder, 1975).

The VAS instrument itself is quite simple, consisting of a horizontal or vertical line ten centimeters in length, labeled at both ends with commonly used and understood descriptive terms which describe the pain experience. As noted earlier, the end points should be labeled to correspond to the absolute minimum and the absolute maximum assessment that could ever be experienced, but should not be so extreme as never to be used (Joyce et al., 1975; Scott and Huskisson, 1976). An example of the tool is given below:

The most pain I could imagine	--------------------------------	The least pain I could imagine

Figure 2. Illustration of VAS instrument

Measure of Obesity

The Body Mass Index scale has been shown to be the most accurate indicator of body mass, and correlates well with other measures of obesity such as triceps skin fold (Sims, 1979). It is simply a measure of weight in kilograms over height in meters squared (Sims, 1979).

Thus, all one needs to do is to obtain the height and weight of the subject and apply these measures to the scale to determine the degree of obesity or leanness. Normal BMI ranges for females are 19-24, overweight for females is considered a BMI of 24-29, and obese is 29 or greater for both sexes (Bray, 1979).

Measure of Fed State

The measure of fed state consisted of the interview question: When did you last finish a meal or a snack? This question was asked by the researcher after the patient had filled out the VAS scale.

In addition, a measure of satiety was obtained by asking the question: Do you feel hungry now? Again, this was asked after the subject had filled out the VAS scale. As noted earlier, a "yes" on the question regarding hunger is equal to a low state of satiety and will be scored as a "1"; a "no" response indicates a high state of satiety, and will be scored as a "2".

Demographic Data

Demographic data were collected to describe the sample. Age, length of stay in the hospital, previous intravenous (IV) venipunctures during this hospitalization. Those patients with greater than five

IV starts were omitted because of possible influence of learning on pain reaction. The number of IV starts was chosen based on the investigators clinical judgment. Height and weight, admission diagnosis and any surgeries performed while hospitalized were also collected. Data on the last narcotic administered was also collected at this time, and information regarding the time of the last food intake were also collected.

Data Collection Protocol

Rounds were made with the IV nurse on the day or evening shift. The IV nurse selected was instructed in the general idea of the study, but kept blind to the exact purpose of the study. Permission was solicited from the subject prior to the venipuncture. Demographic data necessary for selection to the study such as previous venipunctures, type of IV solution, and admission diagnosis to screen for patients with chronic problems with acute exacerbations were collected from the subject's chart before approaching the subject regarding participation in the study. The venipuncture was then performed by the IV nurse. The VAS was administered to the subject within five minutes if the IV was started on the first attempt, the solution type and gauge needle were acceptable (less than or equal to 20 gauge), and if the patient has less than five venipunctures during this hospitalization. Further demographic data regarding height and weight, last narcotic administered, last meal (to determine fed state), age, length of hospital stay, previous venipunctures, admission diagnosis, and any surgeries performed were then collected. The data regarding height and weight were measured by the experimenter immediately following the administration of the VAS. Data regarding the time of the last narcotic was determined through chart review and noted on the data collection instrument. Data regarding the time of the last meal was obtained from the subject herself. Data regarding age, length of hospital stay, previous venipunctures, admission diagnosis and any surgeries performed while hospitalized was collected from chart data.

Data Analysis

Correlations between pain and BMI, and pain and length of time since last meal were determined by using Pearson's Product Moment Correlation Coefficient. Descriptive statistics were used on the demographic data to describe the sample.

Summary

The research design is a descriptive type since the state of the art regarding reaction to pain and fed state, and the reaction to pain and degree of obesity is undetermined. The setting was adult medical/surgical units in a general community hospital. Intensive care and other specialized units were omitted because of difficulties with multiple stimuli acting on subjects at the same time. Sample selection criteria included: white females, English speaking, admitted for an acute problem to a general medical/surgical unit, with no recent (within six months) hospital admissions.

The pain stimulus selected was an IV start. After receiving the pain stimulus, the Visual Analogue Scale (VAS) was administered. Degree of obesity was determined by the Body Mass Index (BMI) measuring weight in kilograms, and height in meters squared. Demographic data were collected regarding age, length of stay in the hospital, previous IV venipunctures (greater than five were omitted from the study), admission diagnosis and any surgeries performed while hospitalized, the number of previous hospitalizations, the time the last narcotic was administered, and the time of the last food intake.

Data analysis consisted of correlations between pain and BMI, pain and length of time since last meal. These were determined by Pearson's Product Moment Correlation Coefficient. Descriptive statistics were used on the demographic data to describe the sample.

CHAPTER IV

DATA ANALYSIS

The characteristics of the sample will be presented first in this chapter. In addition, data analysis relating to the study question will be presented.

Sample Description

The sample selected consisted of 15 white females admitted for acute medical or surgical problems to general medical-surgical wards. All the subjects had an intact spinal cord. The subjects all spoke English and had no hospital admissions within six months of this hospitalization. All subjects had five or fewer IV starts this admission, and the catheter inserted was 20 gauge or less. The IV fluid was a non-irritating type ranging from 5% Dextrose in water, and 5% Dextrose with aminophyllin added, to plain Normal Saline. All IVs were started on the first attempt.

Sample characteristics are given in Table 1. The age ranges for the subjects were from 19 to 88 years, the average age being 62.8 years, a median of 66.0 years and a standard deviation of 19.7 years. The number of previous IV starts ranged from zero to five with a mean of 0.87, and a standard deviation of 1.40. The admission diagnoses ranged from asthma to peripheral vascular disease (see Table 2, Appendix B).

Table 1. Sample Characteristics

	Mean	Median	Standard Deviation	Range
Age	62.8	66.0	19.74	69.0
Previous IVs	0.87	1.0	1.41	5.0
BMI	25.32	25.2	6.19	21.2
Fed State	12.83	4.5	18.52	72.0
Satiety	1.73	1.0	0.46	2.0
Pain Score	36.93	18.0	34.94	97.0

The average BMI score was 25.32 with a standard deviation of 6.19 and a range of 21.2. This indicates a sample that leaned toward the obese end of the normal BMI scale. The average score for state of satiety was 1.73 with a standard deviation of 0.46, indicating a sample which was not hungry at the time of the questionnaire. The average time since the last meal (fed state) was 12.83 hours with a mode of 2.5 and a median of 4.5, a range of 72 hours and a standard deviation of 18.25 hours. The wide standard deviation and difference between mean and median indicates a positively skewed distribution. Only one subject had had any narcotics this admission, eight and one half hours prior to the IV start.

Research Questions

The stated purpose of this study was to discover a link between obesity and pain reaction. In essence, it was hoped that the degree of obesity would demonstrate a link with pain reaction, that is, the more obese the subject, the less the reaction to pain. Additionally, it was hoped that a link between the time of the last food intake and pain reaction could be demonstrated, that is, the greater the time since last food intake, the less the reaction to the pain stimulus.

The mean pain scale score was 36.93 with a standard deviation of 34.94 and a range of 97.0. This indicates that by and large the response to the pain stimulus was not overly large, but rather ranked somewhere near the middle in the range of possible pain experiences. (The higher the pain score, the greater the pain.) The large standard deviation indicates a great deal of sample variability.

Previous experience with IV starts did not correlate with the score on the pain scale indicated by a Pearson's correlation coefficient of 0.0245 and a $p < 0.931$. The gauge of the IV needle did not appear to effect the score on the pain scale. The IVs were started were either a 22 or 20 gauge. The mean pain score for those patients started with a 20 gauge needle was 33.2 with a standard deviation of 39.0, whereas those started with a 22 gauge needle had a mean score of 38.8 with a standard deviation of 34.8. A t-test was performed on this date and the value obtained was -0.28 with 13 degrees of freedom (t-critical=1.771 $p < 0.05$).

Correlation Between Pain and Fed State

Correlation coefficients were obtained on the data of time of last meal and the pain scale score. No correlation existed between these two variables indicated by a correlation of -0.091 with a significance of 0.374. A scatterplot diagram (see Appendix C, Figure 3) was also obtained on this data and two distinct groups were noted. Group one reported less pain regardless of the time of the last meal, and had an average BMI of 26.42, an average age of 54.88, and a hunger score of 1.63 (n=8). Thus, this sample was younger than the overall group, had a slightly higher BMI score, and was slightly more hungry (see Table 3).

Group two reported more pain than group one, and displayed the following demographics: average BMI of 24.06, average age of 71.86, and a hunger score of 1.86, with an n=7. This group was slightly

Table 3. Correlation of Fed State and Pain Groups 1 and 2. (Standard Deviations in Parenthesis.)

	Group 1 Low Pain (n=8)	Group 2 High Pain (n=7)
Mean BMI	26.4 (6.2)	24.1 (6.4)
Mean Age	54.8 (19.6)	71.9 (16.7)
Mean Satiety	1.6 (0.5)	1.9 (0.4)

older than the overall sample, was about average in terms of BMI, and was slightly less hungry (see Table 2).

The difference between these groups might be explained by the difference in hunger scores. Additionally, these differences could be explained by the lower BMI in group two, and possibly the age differences between the groups.

A Pearson's r was performed on the variables of report of satiety and subjective report of pain. A low correlation of 0.25 with a significance of 0.36 was obtained. Thus, the less subjective hunger reported by the subject, the more the pain reported. This indicates that the sated subject may have a lower level of endogenous opiates than the subject with greater hunger, and thus would report more pain.

Correlation Between Pain and BMI

Correlation coefficients were obtained for the BMI score and its relationship to pain. A low correlation was obtained for these data of -0.16 with a significance of 0.29. This indicates a very low correlation between degree of obesity and report of pain; the greater the weight, the less the reported pain.

A scatterplot diagram (see Appendix C, Figure 4) was obtained for these data and three distinct groups emerged. Data on these groups are shown in Table 4. The first group (n=9) reported low pain scale scores regardless of the degree of obesity. Demographics for this group include an average BMI of 25.8, an average age of 58.5, average

Table 4. Comparison of Pain Groups (1, 2, 3). (Standard Deviations in Parenthesis.)

	Low Pain Group 1 (n=9)	Mod. Pain Group 2 (n=3)	High Pain Group 3 (n=3)
Mean BMI	25.8 (6.1)	30.27 (3.1)	18.8 (3.1)
Mean Age	58.5 (21.4)	61 (22.1)	77.3 (1.2)
Mean Fed State	14.9 (22.5)	3.3 (0.76)	16 (11.7)
Mean Satiety	1.67 (0.5)	1.67 (0.76)	2.0 (0.0)

hours since last meal of 14.9 hours, and an average hunger score of 1.67. Thus, this group was younger than the average age of 62.8, average in terms of BMI scores, were nearly average in terms of time of last meal, and were slightly more hungry than the overall sample.

Group two (n=3) rated the pain as worse than group one. The demographics on this sample include an average BMI of 30.27, an average age of 61 years, average time since last meal of 3.33 hours, and an average hunger score of 1.67. This indicates a group with a higher degree of obesity than average, an average time since last meal of much less than the overall sample, and slightly more hungry than the overall sample. The possibility exists that these subjects perceived more pain due to the proximity of the IV needle start to their last meal.

Group three (n=3) perceived the pain as great, and showed some interesting differences from the overall sample. The average BMI was 18.8, the average age was 77.3, average hours since last meal of 16, and a hunger score average of 2.0. Thus, this sample was older than the overall sample, was much smaller in terms of degree of obesity, and was much less hungry than the overall sample.

Age may be important in all groups but groups two and three are too small from which to draw conclusions. A correlation of 0.26 with a $p < 0.18$ was obtained on the data of subjective report of pain and age. This indicates a possible trend in the data. It is possible that there is an interaction among obesity, fed state, and age that influences the response to pain. A larger sample is needed to test this possibility.

Summary

The sample consisted of 15 white females admitted to general medical and surgical wards with acute medical or surgical problems. The average ages for the subjects was 62.8 years. The mean number of IV starts was 0.87, all of the IVs were started on the first attempt. The average BMI score was 25.32, the average time since last meal was 12.83 hours. The mean pain score was 36.93 with a range of 97.0.

Previous experience did not correlate with the pain score. The gauge of the needle used for the IV start did not correlate with the pain scale score indicating that IV size did not influence the reaction to pain.

The correlation between pain and satiety scores of 0.25 ($p <.36$) indicated a trend in that the less hungry the subject, the more pain reported.

Correlations also existed between pain and BMI, but to a lesser degree. A correlation coefficient of -0.16 was obtained ($p <0.29$) indicating a low correlation between obesity and the report of pain; the more obese the subject, the less the reported pain.

There was a very low correlation between time of last meal (fed state) and reported pain. A correlation coefficient of -0.091 with a $p <0.374$ was obtained. This indicates that the greater the length of time since eating, the less the pain reported. However, none of the correlations obtained were statistically or substantively significant.

CHAPTER V

INTERPRETATION OF RESULTS

According to the Theoretical Framework presented earlier, one would expect that the more obese the subject, the less pain that would be reported.. According to the data presented, this seems to occur at a very low level. A negative correlation exists between the BMI and the score on the pain scale. This indicates that the more obese the subject, the less pain is reported. This is, however, a low correlation which was not statistically significant.

State of satiety also seemed to correlate with pain according to this sample. The higher the state of satiety, the more the pain reported. This is indicated by the positive correlation between pain and satiety state variables (a "yes" on the question regarding hunger is equal to a low state of satiety and was scored as a 1; a "no" response indicates a high state of satiety and was scored as a 2). There was also a very low negative correlation between fed state and report of pain. This indicates that the longer the time since eating, the less the pain. Again, this was as hypothesized. None of these values were statistically significant.

Although no significant data were produced, there did seem to be trends in the data to indicate that if the study limitations could be overcome, some significant patterns would emerge.

Limitations

The first and foremost limitation of the study is sample size. With a sample of only 15 subjects, it is difficult to determine whether any changes are due to the phenomena in question or sample selection. The criteria for subject selection also limits the usefulness of the study. Selecting only white females in an acute care setting eliminates some of the intervening variables, but also limits the generalization of the study.

A second limitation is that the pain stimulus selected may not have been intense enough to show any significant differences between the subjects, indicated by the moderate average responses on the pain scale. This may be a function of the subject's mental acceptance of venipunctures as a routine hospital procedure. That is, since nearly everyone has an IV, it is expected and hence not painful. Additionally, the IV therapy nurses are very skilled in venipunctures, and the stimulus may not have been painful. The pain measurement scale selected may also be inappropriate since it has only been used to measure pain relief and not pain reaction. Admission diagnosis was not controlled for an this may have influenced with the results.

There are several other variables discussed in the literature which were not controlled. Prior experience with pain was also not controlled, which could significantly effect the reaction to pain. Additionally, no attempt was made to control for the emotional state of the subjects, which could significantly influence the reaction to pain.

Implications for Nursing Research

Since there were no statistically significant data produced, it would be wise to replicate the study after correcting the problems in research design and the limitations.

The following changes should be made in the data collection procedure: The hunger scale should be a Visual Analogue type where subjects could rate their hunger on a scale rather than a simple yes-no question. This could help supply information on whether or not there is any correlation between degree of hunger and pain reaction. More subjects should be obtained, and they should be tested for stress and anxiety prior to administering the VAS pain scale. This would give information as to whether or not any correlation existed between emotional state and pain reaction. A greater pain stimulus should be utilized to better determine reaction to pain, although one would need to carefully control the amount and kind of pain studied. Cross cultural and cross sex studies should be instituted for the results to be more generalizable. It would also be interesting to see whether or not diagnosis and possibly prognosis have anything to do with reaction to pain.

Implications for Nursing Practice

As was stated earlier, some trends did emerge in the data to make one curious as to the validity of the theoretical framework. If significant data were observed, then it could alter the way patient care is given. Painful procedures could be timed to coincide with times between meals and early in the morning when the patient is in a low fed state. Additionally, it could give nurses some insight into the need for increased pain medication in lean patients when compared to those of their obese counterparts.

With a larger sample, more sophisticated analysis of data could be done which would consider the impact of all the variables together on pain rather than bivariate relationships. Before implications can be drawn, however, more research is required.

Summary

The data collected although not statistically significant did indicate some trends. The low negative correlation between pain and BMI scores tentatively supports the theoretical framework. Fed state, as indexed by both length of time since eating and satiety score, also seems to correlate with pain as was stated in the theoretical framework; the higher the satiety, the more pain reported. Additionally, the longer the time since eating, the less the reported pain.

It was suggested that the study be replicated due to its many limitations, and several changes were proposed. Implications for nursing practice include insight into patient's needs for pain medications, and timing of painful procedures around times when the patient's fed state is low. Before implications can be drawn, however, more research is required.

APPENDIX A

HUMAN SUBJECTS APPROVAL

THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

COLLEGE OF NURSING

MEMORANDUM

TO: Douglas C. Howard, Jr. BSN
1319 S. Lynx Drive
Tucson, AZ 85713

FROM: Ada Sue Hinshaw, PhD, RN ASH Katherine Young, PhD, RN
Director of Research Chairman, Research Committee

DATE: December 26, 1984

RE: Human Subjects Review: Fed State and Obesity in Relation to Pain Reaction

Your project has been reviewed and approved as exempt from University review by the College of Nursing Ethical Review Subcommittee of the Research Committee and the Director of Research. A consent form with subject signature is not required for projects exempt from full University review. Please use only a disclaimer format for subjects to read before giving their oral consent to the research. The Human Subjects Project Approval Form is filed in the office of the Director of Research if you need access to it.

We wish you a valuable and stimulating experience with your research.

ASH/fp

APPENDIX B

DATA COLLECTION

DATA COLLECTION QUESTIONNAIRE

You are being asked to give your opinion voluntarily on the statements in this questionnaire. By responding to the questionnaire, you will be giving your consent to participate in the study, the title of which is Fed State and Obesity in Relation to Pain Reaction. Your name is not on the questionnaire, and there is no way for your questionnaire to be identified as yours once you complete it. You may choose not to answer some or all of the questions, if you so desire. Whatever you decide, your care will not be affected in any way. Your questions will be answered, and you may withdraw from the study at any time. There are no known risks. The purpose of the project is to determine whether or not there is any differences in pain reaction and perception between lean and obese patients, and to discover if there is any link between the time of the last meal and pain reaction and perception.

Please answer the following question like this example:

```
The most fun                                  The least fun
I have ever had                               I have ever had

    |-----------------------------------|---------|
```

Please make a mark on the following line.

Considering the IV just started on me, the pain was:

```
The most pain                                 The least pain
I could imagine                               I could imagine

    |---------------------------------------------|
```

Demographic Data Collection Sheet

Current Date .... ______________

Time last meal was finished ..... ______________ Hungry now? Y N

Current time .... ______________

Age of respondant ,,,,,,,,,,,,,, ______________

Admission date .... ______________

Admission diagnosis .... ______________________________________

Surgery performed .... ______________

Surgery date .... ______________

Date of last hospitalization .... ______________

Reason .... ______________________________________

Number of previous IV starts .... ______________ (This admission)

Gauge of current IV started ..... ______________

Time current IV started .... ______________

IV solution .... ______________

Time of last narcotic .... ______________ (Date if appropriate)

Measured height in meters .... ______________

Measured weight in kilograms .... ______________

Calculated BMI .... ______________ (Weight/(height)2)

APPENDIX C

DEMOGRAPHIC DATA AND SCATTERPLOT DIAGRAMS

Table 2. Summary of Demographic Data

TIME SINCE LAST MEAL	GAUGE IV	IV FLUID	ADM. DX.	PREV. HOSP.	LAST NARCOTIC
0.0 hrs.	22	D5W amin.	Asthma	1981	na
72.0 hrs.	20	D5NS 20 K	Intes. obst.	1982	na
2.5 hrs.	22	D5.45 20 K	Dehyd. UTI	1983	na
2.5 hrs.	22	NS	Severe anemia	1983	na
19.0 hrs.	20	D5W	PVD	1984	na
4.0 hrs.	20	NS	R/O MI	1984	na
2.5 hrs.	22	D5.45	Pneum. pyelo-nephri	1980	na
18.5 hrs.	22	D5W amin.	Incis. hernia	1983	na
5.5 hrs.	22	H.W.	Bron-chitis	1951	na
23.0 hrs.	22	D5.45 20 K	Dehyd-ration	na	na
10.5 hrs.	20	D5.45	GI bld.	1984	na
2.0 hrs.	22	H.W.	Abd. pain	na	na
4.5 hrs.	22	D5.2	HNP	1984	8.5 hrs
22.5 hrs.	20	D5W	GI bld.	1984	na
3.5 hrs.	22	D5W hep.	DVT	1983	na

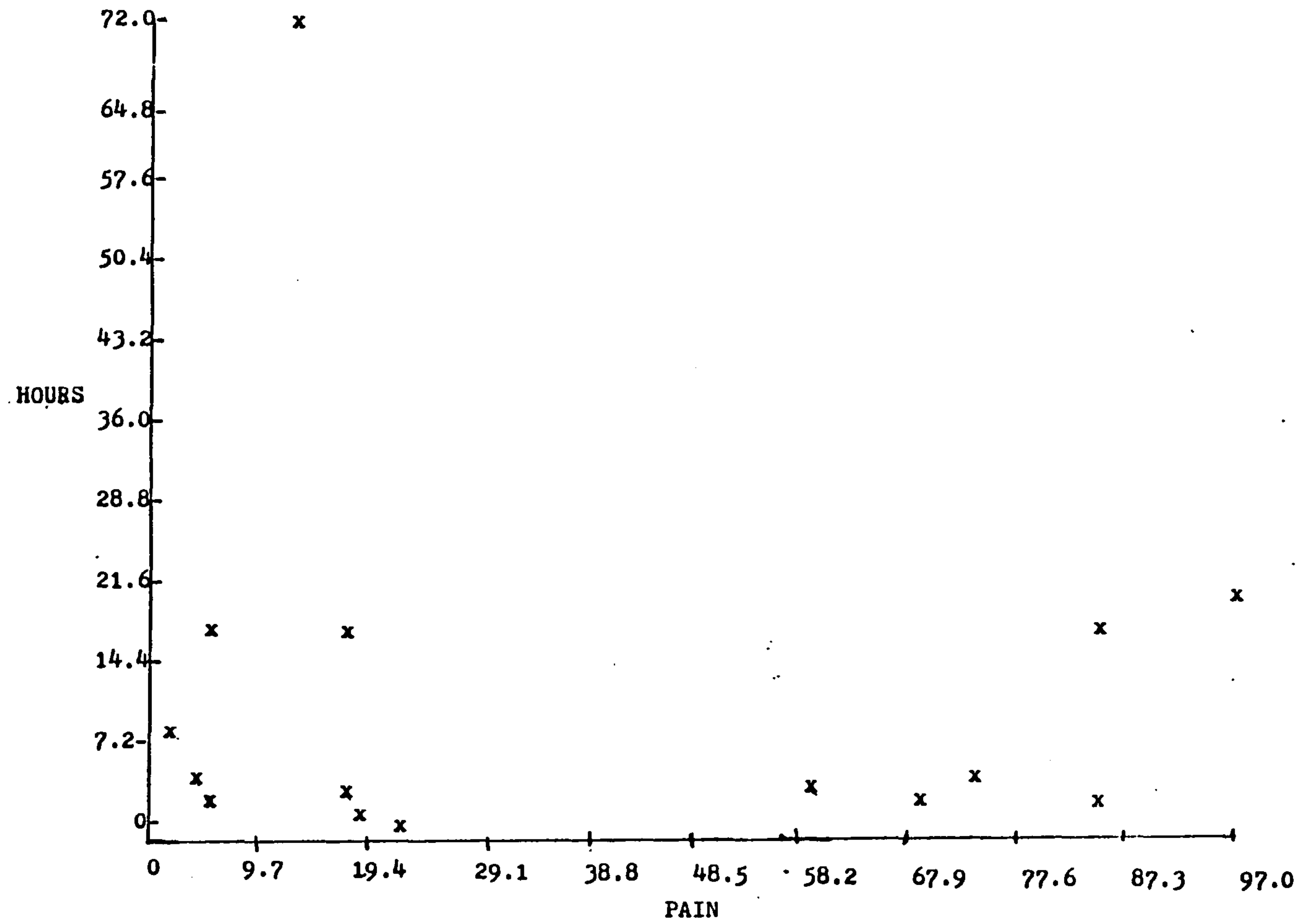

Figure 3. Scatterplot diagram of Fed State and Pain score

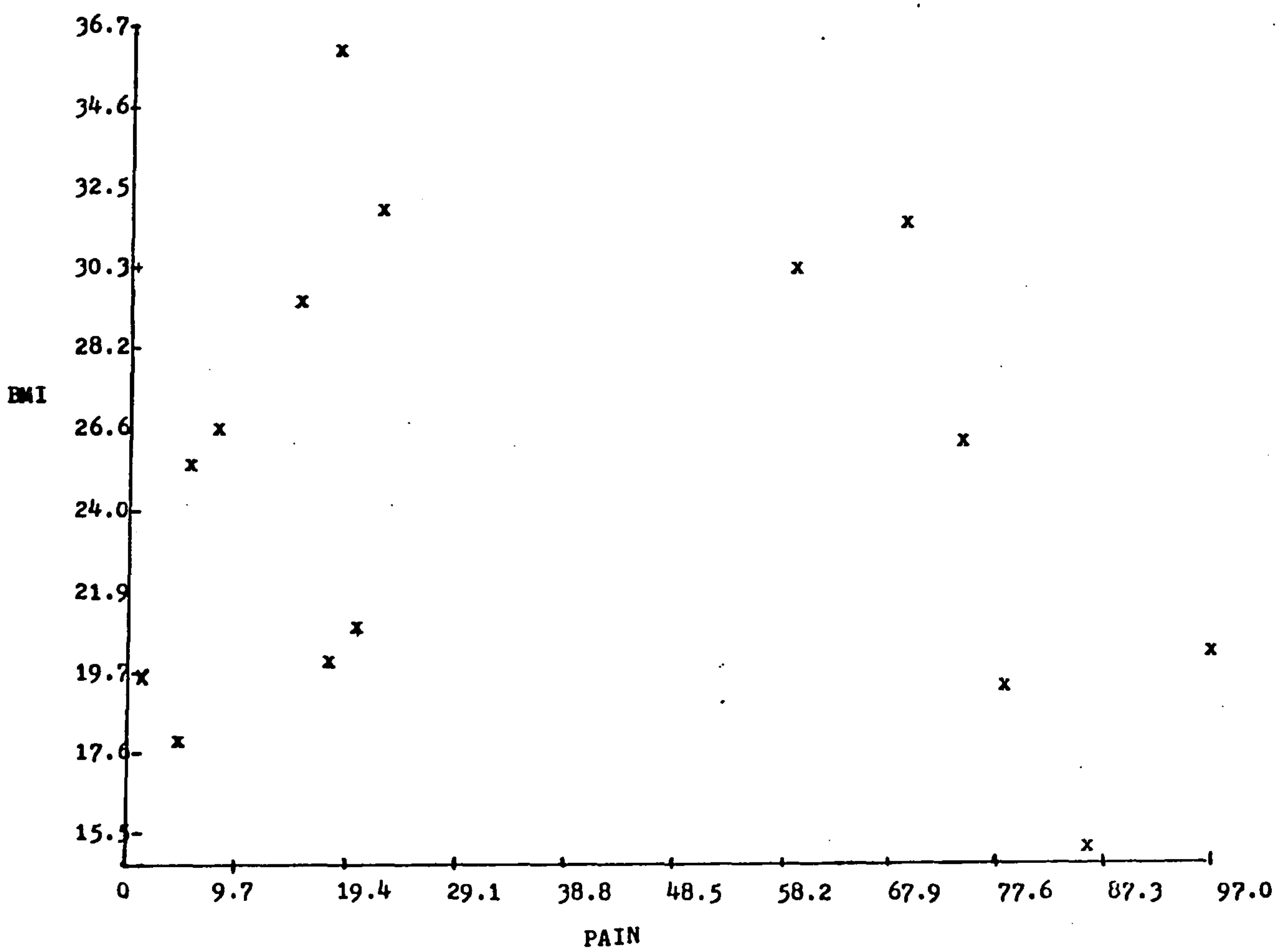

Figure 4. Scatterplot diagram of BMI and Pain Score

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