

Utilizing health programmes for controlling canine genetic diseases in Finland

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by

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Cover:

THE TWO EXTREMES OF DOG BREEDING:

Above: *INTERNATIONAL, FINNISH, SWEDISH, DANISH AND ESTONIAN CHAMPION, COBENHAGEN WINNER 1993 EUROPEAN WINNER 1999, SWEDISH WINNER 1999, Dorthonion Castamir-Coire*. Not only his appearance, but also his mental and physical soundness has fulfilled his owners', breeders' and veterinarians' expectations for an ideal pedigree dog (photo by Studio 86, Vammala, Finland).

Down: His granddaughter **Yarracitta Oiolenkaunokki** who although registered as German Pinscher is sired by a Standard Schnauzer thanks to the co-operation and openminded attitude of the Finnish Kennel Club (photo by T. Eerola).

ABSTRACT

One aim of this thesis was to study the Finnish Kennel Club's control programme for canine genetic diseases (PEVISA), and to evaluate the programme's effectiveness, economic and health benefits. Another purpose was to study different key groups' attitudes, knowledge about and commitment to these programmes. A third aim was to find methods to improve the present health programmes. Three questionnaire surveys were mailed during the years 1997-1998 to 680 veterinarians, 320 dog breeders and 640 dog owners. The response rate in these surveys was 47%, 36% and 36%, respectively. Hip dysplasia records of 64 349 dogs in 22 breeds and ophthalmological examination records of 18 146 dogs were analysed as well as more detailed hip dysplasia and pedigree data of 10 706 German Shepherd Dogs.

The present control programme's effectiveness in decreasing the prevalence of inherited diseases has been limited, and consequently no direct economic benefits can be shown. Only in nine breeds of 22 included in the study were significant changes in hip dysplasia prevalence detected; in four breeds the disease prevalence increased during the study period. As ophthalmological screening programme show that most breeds have very low disease prevalences, no conclusions about the trends can be drawn. In two breeds, disease prevalence increased during the study period: however, this is probably due to changes in examination routines that have made it easier to detect previously undiagnosed mild cases.

Possible reasons for poor success are ineffective selection against genetic diseases in breeding and the present programme's concentration on collecting information, which is, however, not effectively used for more advanced breeding methods. As heritability estimates for hip dysplasia (0.31 to 0.35) in this study were moderate, selection against hip dysplasia should be possible. In spite of the control programme's poor actual effectiveness, the key groups (veterinarians, breeders and dog owners) have a positive attitude toward it and believe in its usefulness. However, veterinarians and dog owners felt that they had limited knowledge and would need more information about genetic diseases and the programme.

In the future the control programme should be planned more individually so that it responds to every breed's specific needs. In programme planning health issues should be integrated into a comprehensive breeding programme. Also goals and objectives should be more precisely specified for each breed. All groups involved in the programme should participate in the planning phase as well as the evaluation of the programme more than they do at present. In the future, recent advances and modern methods of veterinary medicine and animal breeding -- including for example prediction of breeding values and DNA-techniques -- should be used.

KEY WORDS: inherited diseases, canine, screening, control programmes

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11. REFERENCES

1. LIST OF ORIGINAL PAPERS

This thesis is based on the following original papers which are referred to in the text by their Roman numerals, and on unpublished results presented in the text:

- I **Leppänen M., Paloheimo A., Saloniemi H.** Attitudes of Finnish veterinarians about programmes to control canine genetic diseases. *Preventive Veterinary Medicine* **1999**, 38: 239-257
- II **Leppänen M., Paloheimo A., Saloniemi H.** Attitudes of Finnish dog-breeders about programmes to control canine genetic diseases. *Preventive Veterinary Medicine* **2000**, 43: 159-175
- III **Leppänen M., Paloheimo A., Saloniemi H.** Attitudes of Finnish dog-owners about programmes to control canine genetic diseases. *Preventive Veterinary Medicine* **2000**, 43: 145-158
- IV **Leppänen M., Saloniemi H.** Screening and controlling canine inherited ocular diseases in Finland: epidemiological, economical and health promotional aspect. *Veterinary Ophthalmology* **1998**, 1: 203-210
- V **Leppänen M., Saloniemi H.** Controlling canine hip dysplasia in Finland. *Preventive Veterinary Medicine* **1999**, 42: 121-131
- VI **Leppänen M., Mäki K., Juga J., Saloniemi H.** Estimation of heritability for hip dysplasia in German Shepherd Dogs in Finland, *Journal of Animal Breeding and Genetics*, in press
- VII **Leppänen M., Mäki K., Juga J., Saloniemi H.** Factors affecting hip dysplasia in German Shepherds in Finland: efficacy of the current improvement programme. *Journal of Small Animal Practice* **2000**, 41: 19-23

2. ABBREVIATIONS

BLUP	best linear unbiased prediction
CAH	chronic active hepatitis
CEA	collie eye anomaly
CRD	chorioretinal dysplasia
DNA	deoxyribonucleic acid
ED	elbow dysplasia
FCI	Federation Cynologue Internationale
FKC	The Finnish Kennel Club
HC	hereditary cataract
HD	hip dysplasia
FN	familiar nephropathy
PEVISA	The Finnish Kennel Club Control Programme for Canine Genetic Diseases
PHTVL/PHPV	persistent hyperplastic tunica vasculosa lentis / persistent primary vitreous
PRA	progressive retinal atrophy
RD	retinal dysplasia
REML	restricted maximum likelihood
RPED	retinal pigment epithelial dystrophy

3. INTRODUCTION

Advanced diagnostic and treatment options have decreased the importance of infectious diseases as causes of death in dogs. Instead, interest in methods to prevent inherited diseases and their control is increasing.

Over three hundred genetic diseases in dogs are known already and according to Patterson (1993) on average one new disease is identified monthly. Rapid development of new diagnostic methods -- for example DNA-techniques -- has helped in identifying new genetic diseases and also increased our knowledge of previously known diseases, their mode of inheritance, effects on animals and possibilities for controlling them (Schelling et al., 1991; Rothuizen, 1993; Smith, 1994; Nicholas, 1996; Binns, 1997; Holmes, 1998).

Genetic diseases can affect all organs and functions of a dog; however those diseases causing clear clinical signs are the easiest to identify. For this reason the oldest and in many cases the best known are the diseases that affect bones, joints, vision or nerves (Patterson et al., 1989). First reports of progressive retinal atrophy are from the beginning of the century (Magnusson, 1911); some other inherited ocular diseases were identified in the 1920s and 1930s (Barnett, 1976). Schnelle (1935) described hip dysplasia in dogs in 1935, and numerous reports of elbow dysplasia have been published since the 1970s (e.g. Guthrie and Pidduck, 1990; Studdert et al., 1991).

Because many inherited diseases have deleterious effect on dogs' performance and working abilities, the need to control inherited

diseases was realized very early (Paatsama, 1962; Black, 1971). Discussion of animal welfare issues has been very active in recent years, as demands for consideration of health-related issues and sound breeding principles in pet animal breeding have been made by public and authorities alike (Anon., 1995; Anon., 1996). In addition to ethical points of view, economical considerations concerning losses caused by inherited diseases have also been actively discussed recently (Wilcock, 1990; Robertson, 1995). This has led to an increased need to effectively control canine inherited diseases: for this purpose ongoing programmes have to be critically evaluated and methods to improve them or develop new more effective methods are needed.

4. REVIEW OF THE LITERATURE

4.1. THE FINNISH KENNEL CLUB CONTROL PROGRAMME (PEVISA) FOR CANINE GENETIC DISEASES

4.1.1. Background

Increased knowledge of canine inherited diseases, their pathogenesis and genetics promoted the need for control measures. Hip dysplasia (HD) was the first disease that was commonly considered a genetic defect which needed strict control programmes. After Schnelle (1954) proposed the first classifying system in 1954, control programmes were started in many countries in the late 1950s and other countries followed in the 1960s (Paatsama,1962; Paatsama, 1978; Paatsama, 1979; Freudiger et al., 1973; Bargai et al., 1988; Hedhammar, 1991; Hedhammar et al.,1996; Willis, 1997; Paatsama, 1998).

Since then control programmes for other inherited diseases, e.g., elbow dysplasia (ED) and inherited ocular diseases, have also been established in many countries (Jolly et al., 1981; Bedford, 1989; Walde and Neumann, 1991; Anon., 1993; Paatsama, 1978; Hedhammar et al., 1996). The first PEVISA programme was started in Finland in 1984, when hip radiographs of parent animals were required for retriever breeds as a prerequisite for litter registration. In 1988, the first Finnish eye screening programme was established for collies and Dobermans. The present directives for the Finnish Kennel Club Control Programme for Canine Genetic Diseases (PEVISA) were accepted by the Council of the Finnish Kennel Club on 20 November, 1993 (Anon., 1998).

4.1.2. Present situation

Ninety-two breeds have an official PEVISA programme. Breeds, diseases included in the programme and restrictive methods for each breed are accepted by the Board of the FKC after an application from the official breed club. The application of a breed club must be accepted in two general meetings of a breed club, and it must be based on previous screenings or other results that confirm the disease frequency or its clinical importance to the breed.

The programme is based on obligatory screening of all breeding animals. All screened animals must be identified either by tattoo or a microchip. All screening results are registered by the FKC and are public to breed clubs as well as breeders. In some breeds only screening is compulsory, but for some breeds and diseases, screening results may forbid a dog from being used in breeding.

4.1.3. Genetic diseases in the Finnish Kennel Club Control Programme (PEVISA)

4.1.3.1. Orthopedic diseases

Hip dysplasia

Canine hip dysplasia is commonly considered to be a quantitatively inherited trait. Heritability estimates between breeds in different studies vary from 0.17 to 0.6 (Fisher, 1979; Lingaas and Klemetsdaal, 1990; Swenson et al., 1997A; Tomlinson and Mclaughlin, 1996). Environmental factors -- such as feeding and exercise -- and their role in development and severity of hip dysplasia have also been widely studied and discussed (Aichinger, 1997; Brass, 1989; Schwalder et al., 1996; Swenson et al., 1997A; Tomlinson and Mclaughlin, 1996).

The PEVISA hip dysplasia control programme is based on subjective evaluation and scoring of standardized radiographs. The scoring is done according to the FCI-scoring system (Brass and Paatsama, 1983) by veterinarians authorized by the FKC. For 73 breeds, hip scoring is demanded before breeding. Thirty-two of these breeds have threshold scores for hip dysplasia that exclude a dog from breeding. These threshold values vary between breeds: in some breeds only dogs with no signs of hip dysplasia (grades A and B) can be used for breeding, and some breeds discard only the most severe form of hip dysplasia (grade E).

There are different opinions as to the clinical importance of hip dysplasia and of the possibilities to predict the development of clinical signs from radiographs. Joint laxity has been shown to be important in predicting hip dysplasia and degenerative joint disease. Susceptibility for degenerative changes has also shown to have significant between-breed variation, e.g., German Shepherds seem to be more prone to develop degenerative joint disease than Rottweilers (Lust, 1997; Popovitch et al., 1995; Smith, 1997). Also the reliability of subjective scoring systems has been questioned (Stur et al., 1996; Flückiger, 1997; Smith et al., 1997), but no objective system has yet been presented.

Elbow dysplasia (ED)

Elbow dysplasia (ED) is a developmental disorder of the elbow joint. ED was reported in the veterinary literature for the first time in 1974 (Olsson, 1974) and ever since, its importance as a cause of forelimb lameness has been widely recognized. The term ED includes several different pathological changes in the elbow joint such as fragmented

coronoid process (FCP), osteochondritis dissecans (OD) and ununited anconeal process (UAP) (Gröndalen, 1979; Hayes et al., 1979; Studdert et al., 1991). Elbow dysplasia is shown to be a quantitatively inherited trait with moderate heritability (Guthrie and Pidduck, 1990; Gröndalen and Lingaas, 1991; Swenson et al., 1997B).

The screening protocol for elbow dysplasia was developed by the International Elbow Working Group (Paatsama, 1992; Audell, 1993). In Finland, screening for elbow dysplasia was started in guide dogs in 1978 and more widespread voluntary screening for risk breeds in the 1980s (Paatsama, 1984; Mäki, 1998). Bernese Mountain Dog was the first breed to be officially screened for ED in 1994. At present 14 breeds have obligatory elbow screening in health programme. Standardized radiographs are evaluated by the same veterinarians who score hip radiographs for the FKC. Elbows are scored from non-affected (grade 0) to affected from grade I (mildly affected) to grade III (seriously affected).

Patella luxation

Either medial or lateral patella luxation has been diagnosed in numerous breeds, but typically it is seen in small toy or terrier breeds. The severity and clinical symptoms of the luxation vary. Congenital anatomical deformities of the hind leg cause recurrent luxation with no trauma association (Piermattei and Flo, 1997). The inheritance of patella luxation is not clear, but breeding with affected animals is not advisable (Putnam, 1968; Priester, 1972). Patellar examination was added to the control programme of the Finnish Spitz in 1994, and currently palpatory examination for patella luxation is required for six breeds. The palpation is done according to a certain protocol, and

there are approximately one hundred veterinarians with special training who are entitled to issue official patella certificates. Especially toy breed clubs promote voluntary examination before accepting dogs in breeding. These unofficial certificates are not registered with the FKC.

4.1.3.2. Ocular diseases

The FKC gave authorization to few veterinary ophthalmologists to give official FKC eye certificates in 1985. Before that time unofficial certificates were given by some veterinarians who had specialized in ocular diseases. The first official control programme for inherited eye diseases was started 1988 when an eye examination certificate based on an ophthalmological examination was required for Dobermanns and collies that were supposed to be used for breeding. At present there are 19 approved eye panelists who examine about 8000 dogs annually (Liman, personal comm.). Forty-five breeds have obligatory eye screening and in 20 breeds the diagnosis of inherited ocular diseases will exclude a dog from breeding.

Collie eye anomaly (CEA)

CEA is a congenital disease of the posterior parts of the eye. It is caused by a defect in embryonic differentiation. It has been diagnosed in collie breeds and is thought to be an autosomal recessive trait (Yakely et al., 1968; Rubin, 1989). Ophthalmoscopically, CEA is usually divided in three form. Chorioretinal dysplasia (CRD) is the mildest form and may have very little effect on sight. These minor changes are found best in puppies under three months of age. Later these changes can be hidden by retinal pigmentation, and dogs can be classified normal in ophthalmoscopic examination. Coloboma of the optic disc can vary in size and effects. Small colobomas have little or

no effect on vision, but large colobomas may cause marked reduction of vision. The most serious form of CEA is retinal detachment, often accompanied by intraocular bleeding. Detachment can be congenital or usually occurs early in life -- before seven weeks -- but it can also appear later, then usually between one to two years of age. Retinal detachment causes severe loss of vision and in serious cases total blindness (Bjerk s, 1991; Narfström et al., 1997; Rubin, 1989).

Glaucoma

Glaucoma is perhaps the most painful eye disease in dogs. It can be secondary due to some other ocular disease or primary that is due to an inherited defect in the aqueous drainage pathway (Bedford, 1997). Primary glaucoma can be subdivided into narrow-angle and open-angle type. Cottrell and Barnett (1987) have showed the angle closure form to be dominantly inherited in Welsh Springer Spaniels, and open-angle glaucoma in Beagles is caused by an autosomal recessive gene (Gelatt and Gum, 1981). In other affected breeds the mode of inheritance of narrow-angle glaucoma has not been established yet. Typical breeds for the disease are spaniel and spitz breeds. Narrow-angle glaucoma is usually diagnosed in middle-aged or older dogs. Toy and Miniature Poodles can be affected by both open-angle and narrow-angle glaucoma. There is a need for further studies to establish the mode of inheritance of glaucoma in most breeds affected. (Barnett, 1988; Smith, 1989; Gelatt, 1991).

Hereditary cataract (HC)

Inherited cataract can sometimes appear congenital and is often associated with other ocular malformations, such as microphthalmia. In most affected breeds the mode of inheritance has not been

established. The more common form of inherited cataract is developmental. Then the symptoms can be seen later in life. Cataract has been proven or is suspected to be hereditary in many breeds and the list of affected breeds is continuously growing. There is a great variety among different breeds concerning the age of onset and the speed of progression. The shape and location of cataract opacities also have some breed specificity. In some breeds there even seem to be two different forms of inherited cataracts: an early-onset, rapidly progressing form and a late-onset, slowly progressing form, both of which are supposed to be caused by different genes (Narfström et al., 1997; Barnett, 1988; Smith, 1989; Dodds et al., 1981).

Lens luxation

Lens luxation affects mostly terrier type dogs, usually at three to four years of age. It is a displacement of the lens due to the degeneration of its suspensory apparatus. In most patients lens luxation can lead to secondary glaucoma. Recessive inheritance has been shown in several terrier breeds and Border Collie (Barnett, 1988; Rubin, 1989; Bedford, 1997).

Persistent hyperplastic tunica vasculosa lentis / persistent primary vitreous (PHTVL/PHPV)

Persistent hyperplastic tunica vasculosa lentis / persistent primary vitreous is a congenital eye anomaly that has been described in detail by Stades (1980) in Dobermanns in the Netherlands. Further studies in Dobermanns and also in Staffordshire Bull Terriers could prove the disease to be inherited, the mode of inheritance in Dobermanns is probably incomplete dominant (Stades, 1983). For Staffordshire Bull Terriers, also autosomal, recessive inheritance has been suggested (Leon et al., 1988). It has also been suggested that heterozygous dogs might be phenotypically free or show grade I signs

(Stades, 1983; Leon et al., 1988). There are also clinical findings of PHTVL in other breeds, but their number is so small that no conclusion about inheritance can be made. Clinically PHTVL can be divided in subgroups according to the severity of the symptoms. PHTVL can be diagnosed already in puppies, although mild, grade I cases can sometimes be misdiagnosed as free, when not examined biomicroscopically. More severe forms can also be difficult to distinguish from primary cataract or retinal detachment (Stades et al., 1991; Boeve et al., 1992; Bjerk s ,1990; Narfström et al., 1997.)

Progressive retinal atrophy (PRA)

The name PRA covers several types of retinal dysplasias or degenerations. All forms of PRA are progressive and inherited, although there is great variety in expression and etiology in different breeds (Clements et al., 1996; Petersen-Jones, 1998). Ophthalmoscopically PRA is divided into generalized and central PRA. Central PRA is also called “retinal pigment epithelial dystrophy” (RPED). Generalized PRA has proven to be inherited recessively; the only exception is the Siberian Husky, which has sex-linked inheritance of PRA (Acland et al., 1994), the inheritance of RPED remains unclear (Bedford, 1997). There are proofs for both recessive and dominant inheritance, and environmental factors may also have a role in expression (Bedford, 1989; Bjerk s,1991A; Narfström et al., 1997).

Retinal dysplasia (RD)

Primary retinal dysplasia is believed to be inherited as an autosomal recessive trait. It has been described in a number of breeds with a large variety from spots around retinal vessels to complete detachment of the neuroretina. Retinal detachment causes total blindness, but dogs with retinal folds have practically no impairment of vision. Retinal dysplasia can also be secondary

due to intrauterine trauma, maternal infections or various other causes (Barnett, 1988; Bedford, 1997; Narfström et al., 1997).

Superficial punctate keratitis

Superficial punctate keratitis is seen occasionally in all breeds, but most commonly in the Longhaired Dachshund thus causing suspicions of genetic background. The disease has been suggested to have recessive inheritance (Brandsch and Nicodem, 1982). It is supposed to be immune-mediated, but the pathogenesis is not totally understood (Rubin, 1989; Narfström et al., 1997).

4.1.3.3. Other diseases

Dobermann hepatitis

Dobermanns have high incidence of chronic liver disease that is reported to have genetic background (Speeti, 1998). Dogs in a subclinical stage of the disease have continuously elevated liver enzymes (Speeti et al., 1996). Since 1995, all breeding Dobermanns must have two liver enzymes -- alanine amino transpherase and alkaline phosphase -- examined less than 10 months before the dogs are accepted for breeding.

Copper toxicosis

Inherited copper toxicosis is an autosomal recessive disease of Bedlington Terriers Clinically the disease manifests itself as acute or chronic liver failure, but many dogs can remain asymptomatic for long periods in spite of copper accumulation in the liver (Johnson et al., 1980; Eriksson, 1983; Herrtage et al., 1987). The disease can be diagnosed from liver biopsies, but recently also a DNA marker test was developed (Binns, 1997). In Finland, since 1 January, 1998 all breeding Bedlington Terriers have to be tested either with liver biopsy or DNA test.

Familial nephropathy

In the English Cocker Spaniel an autosomal, recessive form of familial nephropathy is known (Steward and Macdougall, 1984; Nash, 1989). According to the PEVISA scheme no offspring of an identified carrier is registered, but no diagnostic or other control measures are required.

Mitral valve insufficiency

The Cavalier King Charles Spaniel is shown to have higher prevalence of mitral valve insufficiency at a younger age than other breeds on average (Häggström et al., 1992). Another study indicated that the development of mitral insufficiency in this breed is due to a polygenic threshold trait (Swenson et al., 1996). Since 1997 a certificate of heart auscultation has been required for Cavalier King Charles Spaniels before breeding.

4.2. HEALTH PROMOTION AND HEALTH PROGRAMMES

4.2.1. Implementing a health programme

4.2.1.1. Programme planning

Traditionally health programmes have focused on primary prevention or health protection, that is on disease avoidance or control of disease incidence (Stachtchenko and Jenicek, 1990; Beitz, 1998). For a successful prevention programme the disease in question must meet certain criteria:

- 1) The disease frequency must be sufficiently high to make the disease economically or socially important to control in target population (Jolly et al., 1981).
- 2) The incidence of the disease within a breed must be verified with appropriate surveys and screening (Jolly et al., 1981; Rubin 1989; Slater, 1996).

- 3) The disease must be well-defined and described in order to enable the diagnosis.
- 4) Diagnostic methods and tests should be simple enough and economically feasible (Jolly et al., 1981; Rubin 1989).
- 5) In the case of controlling inherited diseases the mode of transmission of the disease in question must be known (Rubin, 1989).
- 6) The goal of the control programme, which may be either complete elimination or reduction of the incidence, must be established by the key groups, e.g. a breed club, breeders and dog-owners. Clearly defined objectives and consensus about the goals of a programme among various groups is essential for the success of a programme.
- 7) Because primary prevention demands active involvement of key groups, test methods and control measures should be acceptable to them. This requires educational measures, so that key groups learn to understand the rationale and importance of the programme and also modify the actions accordingly (Jolly et al., 1981; Rubin, 1989; Beitz, 1998). Key groups' own success in establishing programme goals and measures used ensures that key groups find the programme useful and beneficial to them and thus motivates target groups for better commitment, which is vital for maintaining a functional programme. Without realistic goals and objectives commitment is difficult to achieve.

4.2.1.2. Programme evaluation

A successful health programme needs careful evaluation. Evaluation can be aimed at the process, impact or outcome of the programme (Downie et al., 1992). Evaluation is needed to assess the methods and the use of resources, as well as the short-term and long-term effects of the programme and ethical considerations (Downie et al., 1992; Beitz, 1998). Without clear objectives evaluation is very difficult. Thus objectives should be specific, measurable,

achievable, results-oriented and timely (SMART). Unrealistic expectations of the programme's impacts can lead to disappointments; thus early evaluation should have emphasis on the process itself and not yet on the outcome (Downie et al., 1992). Evaluation of economic benefits can be difficult and misleading: economic measurements that are able to take all of the actual costs and benefits into account are in most cases very difficult to construct. Also in many cases measurements of short-term economic results is done, but evaluations of future benefits are forgotten or in practice impossible to perform (Richardson, 1998). In many cases the outcomes and benefits of a health programme are not economic, but focus instead more on disease prevention, individual or social well-being. Depending on the disease in question and the anticipated outcome, measurements of benefits can be made with appropriate clinical trials or health surveys (Stachtchenko and Jenicek, 1990; Richardson, 1998).

4.2.2. Values , attitudes and health behaviour

4.2.2.1. People and pets

Animals can have different roles in people's lives: they can be objects or status symbols for their owner's ego or they can be used, for work for example in hunting (Beck and Katcher, 1983; Savishinsky, 1986). In modern society companion animals are more and more seen and treated as human beings that serve their owners as friends, partners, children or child substitutes. A pet may even act as an extension of its owner, when the owner projects his or her own personality onto the animal and absorbs the animal's nature (Beck and Katcher, 1983; Savishinsky, 1986; Serpell, 1986; Hirschman, 1994). On the other hand for some people a dog can be an aid for example hunting or other work or a producer of merchandise (puppies) to sell. Thus the treatment a dog gets and decisions an owner makes for a dog can be

dependent of its role and very variable according to the owner's attitudes to and expectations of a dog.

4.2.2.2. Attitudes, information-search and decision strategies

Knowledge and information is necessary but not sufficient to appropriate health behaviour (Rudd and Glanz, 1990). This is valid in a person's own behaviour and decision making , but also in decisions and actions a dog-owner or a breeder takes for his or her animal. Information must be relevant and understandable to a target group to ensure effective communication, well-informed decision making, satisfaction and co-operation between customers and providers (Joos and Hickam, 1990). A person's health behaviour and attitudes can be affected by his or her personal feelings of self-management or social reactions to his or her attitudes. Also, initiation and maintenance of health-related behaviour need different conditions (Siegrist, 1988). Attitudes are acquired through personal experiences and are relatively stable. However they can change or be changed. This change most often takes place through new information which is inconsistent with a person's previous attitudes and beliefs. The change is affected by the type of information, the communicator's prestige and assumed intentions as well as by the target groups' previous commitments, likes and dislikes or how appealing they find the new information (Downie et al., 1992).

Information search and methods of handling the information in decision-making processes can greatly vary according to a person's level of expertise. In their decision-making processes experts and consumers focus on different types of information and handle the information differently. In addition to cognitive activity in decision making and behaviour, consumer choices are based on emotions. Consumers judge the information more based on subjective feelings and make holistic classification and choices (Alba and

Hutchinson, 1987; Elliot, 1998). Social environment has more effect on consumers than on experts: consumers are more likely to make decisions which they find socially acceptable. Also, they tend to avoid unpleasant knowledge, and they interpret information so that it is emotionally more pleasing to them (Elliot, 1998).

5. AIMS OF THE PRESENT STUDY

The purpose of the thesis was to critically evaluate the Finnish Kennel Club's ongoing programme for canine genetic diseases and to find methods to improve its efficacy. In order to reach this purpose this study concentrated in three main areas:

- 1) Evaluation of different key groups' attitudes toward canine health control programmes, their knowledge, information sources and commitment (I - III).
- 2) Evaluation of effectiveness, economical and health benefits of current canine health control programme in Finland (IV, V)
- 3) Assessing methods to improve canine health control programme and evaluate the possibilities to use genetic selection for canine health programme (VI; VII).

6. MATERIALS AND METHODS

6.1. SURVEYS (I-III)

Three mailed questionnaire surveys were conducted in 1997-1998. The first was sent to practising veterinarians in Finland. The second survey was sent to breeders and the third to owners of the same sixteen breeds (Table 1). All

Table 1. Number of sent questionnaires and received answers in surveys to Finnish veterinarians (Study I), dog breeders (Study II) and dog owners (Study III).

	sent (n)	received (n)	response rate (%)
veterinarians	680	319	47
dog breeders	320	108	36
dog owners	640	214	36

surveys were basically identical in order to enable comparisons between the groups, but some minor adjustments were made, mostly in phrasing and terminology, so that the questionnaire was understandable to each group. The veterinary survey was sent to all 680 veterinarians categorized in the membership files of the Finnish Veterinary Association as practicing. The breeds included in the study were chosen according to their participation and success versus failure in health programmes (Table 2). Each breed's success or failure was evaluated in epidemiological studies (IV, V). For the breeder survey, ten breeders with the highest number of puppy registrations for the previous five years and ten others were included in each breed. For the owner survey twenty dog owners who had purchased a dog in 1997 and twenty who had purchased one in 1993 were randomly chosen in each breed.

Table 2. Breeds included in the survey of Finnish dog breeders' and dog owners' attitudes about control programmes for canine genetic diseases and each breed's inclusion criteria.

	Inclusion criteria		
	affected breed ranking ^a	success in hip program ^b	success in eye program ^c
German Shepherd	1	no	NA
Labrador retriever	2	yes	yes
Pug	3	NA	NA
Golden Retriever	4	yes	yes
English Cockerspaniel	5	yes	no
Saint Bernhard	9	no	NA
Rottweiler	10	yes	NA
Boxer	13	no	NA
Rough Collie	15	no	no
Doberman	23	no	no
Flat-coated Retriever	NA	yes	yes
Longhaired Miniature Dachshund	NA	NA	yes
Miniature Poodle	NA	NA	no
Toy Poodle	NA	NA	no
Wirehaired Dachshund	NA	NA	yes

a = Breeds that were mentioned most often when Finnish veterinarians were asked to name especially "sick" breeds (Study I).

Breeds are ordered from the highest to the lowest ranking.

b = Breeds that succeeded versus non-succeeded in hip dysplasia control programme (Study V).

c = Breeds that succeeded versus non-succeeded in eye disease control programme (Study IV).

NA = not applicable / no data available.

6.2. EVALUATION OF THE CONTROL PROGRAMME FOR INHERITED OCULAR DISEASES (IV)

Ophthalmological examination records of 18 146 dogs that were born in 1988-1996 and officially screened before 1 January 1997 were included in the study. Only those breeds with more than 700 registered puppies during the previous five years and official screening programmes started before that were chosen. For Dobermanns and collies another dataset was also included, consisting of all the dogs born in years 1988-1997 that were officially

examined before 12 December 1997. This data gave scorings for PHTVL in Dobermanns and CEA in collies.

6.3. EVALUATION OF THE CONTROL PROGRAMME FOR HIP DYSPLASIA (V)

This study included hip dysplasia records for 64 349 dogs in 22 breeds. Nineteen of these breeds have had official control programmes for at least five years and the number of registered puppies in each breed has exceeded 700 during the last five years. Rottweilers were also included in the study as a model for a breed with active voluntary screening. On the other hand Saint Bernard Dogs were included as a model of a breed that is commonly thought to be characterized by severe hip dysplasia and whose breeders commonly oppose breeding restrictions.

6.4. ECONOMIC EVALUATIONS (IV, V)

Costs of ophthalmological examination were calculated using estimated lowest, average and highest costs per dog. Costs of finding affected dogs were calculated separately.

For hip dysplasia the average screening cost per dog was estimated to be FIM450 (\$80), including veterinary fees and the Kennel Club's screening fees. In the calculation models an average puppy price of FIM3600 (\$635) and an average veterinary fee of FIM500 (\$90) were used. To calculate the benefits, the change in the number of dysplastic dogs and those having severe dysplasia (grades D or E) was estimated on the basis of discovered change in dysplasia prevalence between the dogs that were screened before 1988 and those that were born in 1988-1995. In those breeds with increased dysplasia

prevalence the number of saved animals was thus negative, leading to negative values in calculations of benefits in relation to costs. All calculations were made within a breed. Models 1 and 2 are based on the assumption that all dysplastic versus severe dysplastic dogs are replaced immediately (Swenson et al., 1997A). In the other models it is assumed that a certain number of dysplastic dogs are replaced immediately and others need additional veterinary care and medication because of hip dysplasia, resulting in extra costs (Table 3).

In those breeds with significant changes in dysplasia prevalence, a calculation was made of the number of animals that should be saved from hip dysplasia in order to reach a benefit/ cost ratio of 1 with Model 1. In order to be able to better compare the breeds the difference between the actual and expected number of saved animals as a ratio of the number of examined animals in every breed was also calculated.

6.5. HERITABILITY OF HIP DYSPLASIA IN GERMAN SHEPHERD DOGS, ENVIRONMENTAL EFFECTS AND GENETIC CHANGE (VI-VII)

Hip dysplasia records of 10 706 German Shepherds from the Finnish Kennel Club's data bases were used in order to estimate the heritability of hip dysplasia and environmental effects and to predict breeding values and to estimate genetic change achieved with the breeding programme.

6.6. STATISTICAL ANALYSIS

Statistical analyses were performed using Statistix™ Version 4.1. Analytical Software, Tallahassee, Fl., USA. In Studies VI - VII the programme package

PEST (Groeneveld, 1990), including a variance component estimation programme REML VCE4 (Groeneveld, 1997), was used.

In Studies I-III The Wilcoxon signed rank -test was used to analyze the differences of the importance of the various sources of information. The same test was used for comparison of the frequency of different reasons to euthanize young dogs (Studies I-II). The Friedman two-way analysis of variance by ranks followed by multiple comparison tests was used for ranking the importance of different health actions and diseases. In addition, for the comparison of different key groups' opinions of the level of knowledge between each group, the Friedman analysis was followed by multiple comparison tests. Differences between each subgroup were compared with the Mann-Whitney-u or the Kruskal-Wallis tests (Studies II-III).

In Study IV the χ^2 -test was used to calculate the significance of the number of CEA- or PHTVL-affected animals in the beginning and at the end of the study period and the differences between the various groups of pooled data for Dobermanns and collies.

In Study V χ^2 -test was used to analyze the within-breed heterogeneity of the study groups for hip dysplasia. Fisher's exact test was used for comparisons between breeds with or without breeding restrictions.

In Studies VI and VII fixed effects were first tested with a logistic regression model. Variance and covariance components for hip dysplasia were estimated by applying the Restricted Maximum Likelihood (REML) method (Patterson and Thompson, 1971). The BLUP (best linear unbiased prediction) procedure (Henderson, 1984) with the PEST programme (Groeneveld, 1990) was used to estimate the fixed effects and breeding values. The heterogeneity between

the groups with different parental HD scores in different age groups was tested with the 2-test.

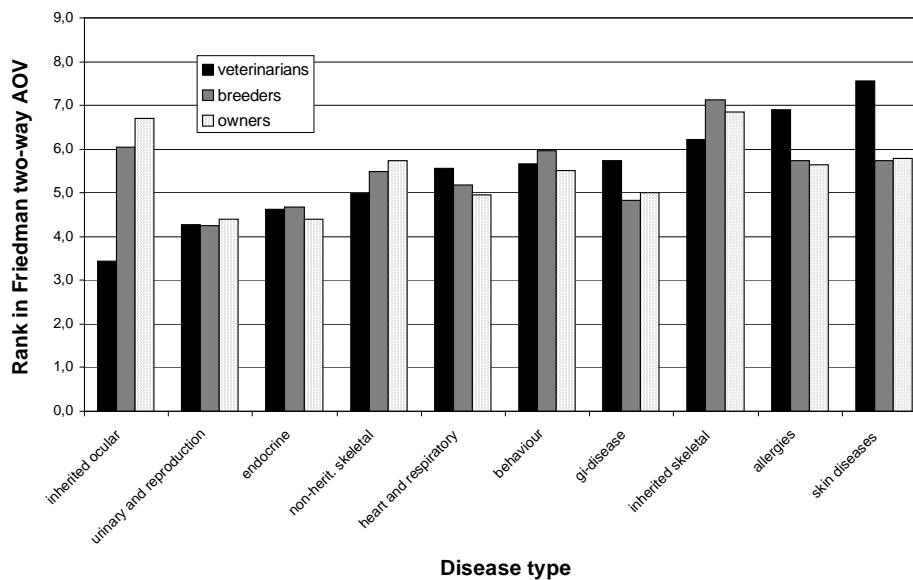
7. RESULTS

7.1. ATTITUDES AND COMPLIANCE OF THE KEY GROUPS

(I-III)

Breeders and dog owners find inherited skeletal and ocular diseases to be the most important ones affecting canine well-being. The veterinarians had a different opinion, ranking skin diseases and allergies highest. They even ranked inherited ocular diseases as the least important disease type (Figure 1). This difference is probably due to the veterinarians' broader clinical experience.

Figure 1. Ranking (in Friedman two-way analysis of variance) of importance of different disease types to canine well-being according to Finnish veterinarians, dog breeders and dog owners.



Of all the key groups studied, breeders estimated their own level of knowledge to be the best. Other groups believed their own knowledge to be more limited. For all the key groups important sources of information at present and in the future were judged to be very similar. The Kennel Club's and breed clubs' role as source of information, even for experts (veterinarians and breeders), was

considered essential, but expert groups' educational role for non-experts (especially owners, but also in some extent for breeders) was also thought to be very important. For veterinarians, professional education and literature were also supposed to be very effective sources that could have more importance in the future (Figures 2 and 3).

Figure 2. Ranking (in Friedman two-way analysis of variance) of importance of different sources of information about canine health programmes for different key groups at present according to Finnish veterinarians, dog breeders and dog owners.

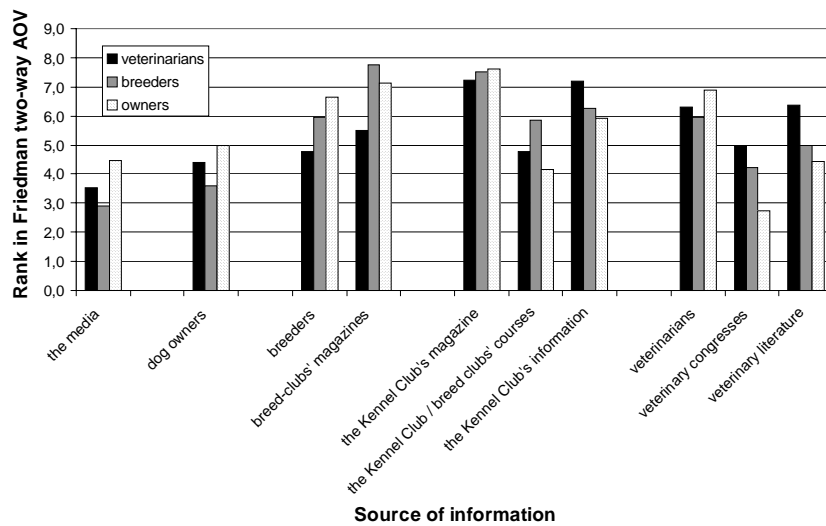
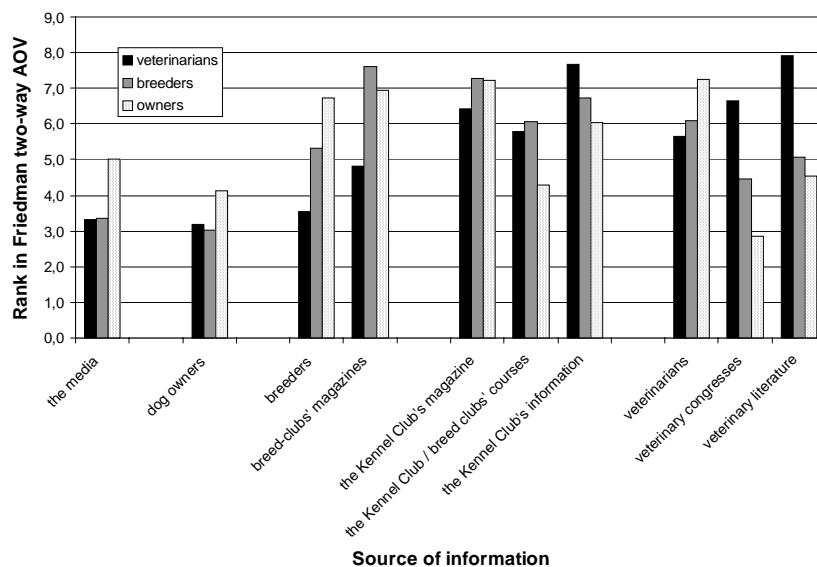
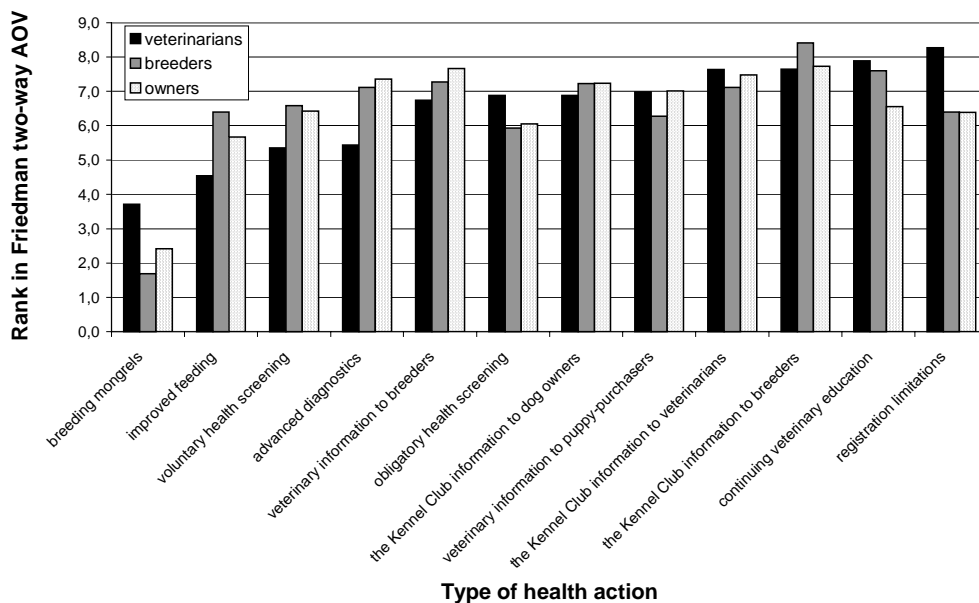


Figure 3. Ranking (in Friedman two-way analysis of variance) of possible future importance of different sources of information about canine health programmes for different key groups according to Finnish veterinarians, dog breeders and dog owners.



All key groups shared very positive attitudes towards the present health programme. According to veterinarians and breeders, obligatory and voluntary health screenings and registration limitations were considered to be amongst the most effective of the current programme's actions for canine health. In the future, however, all groups believed that educational actions directed to key groups could have a very positive effect (Figure 4). However, veterinarians believed more on registration limitations' and obligatory health screenings' effectiveness also in the future than the other groups.

Figure 4. Ranking (in Friedman two-way analysis of variance) of estimated effectiveness of possible future health actions to canine health according to Finnish veterinarians, dog breeders and dog owners.



7.2. EFFECTIVENESS OF THE PRESENT CONTROL PROGRAMME

7.2.1. Inherited ocular diseases (IV)

7.2.1.1. Disease frequency

For most breeds included in the study, frequencies of inherited ocular diseases are very low and cases tend to be detected by accident.

Consequently, no conclusions regarding trends and changes in disease frequencies can be drawn. Only the frequencies of CEA in Rough Collies (30.9%) and Smooth Collies (12.1%) as well as PHTVL in Dobermanns (21.4%) exceeded 10%. In Rough Collies as well as in Dobermanns, a significant increase in disease frequencies during the study period was also noticed. In both breeds, however, the trend was towards milder grades of diseases, and the detected increase is probably due to improved screening routines and methods (biomicroscopy), which enable the milder forms to be detected more reliably than before.

7.2.1.2. Economic effectiveness

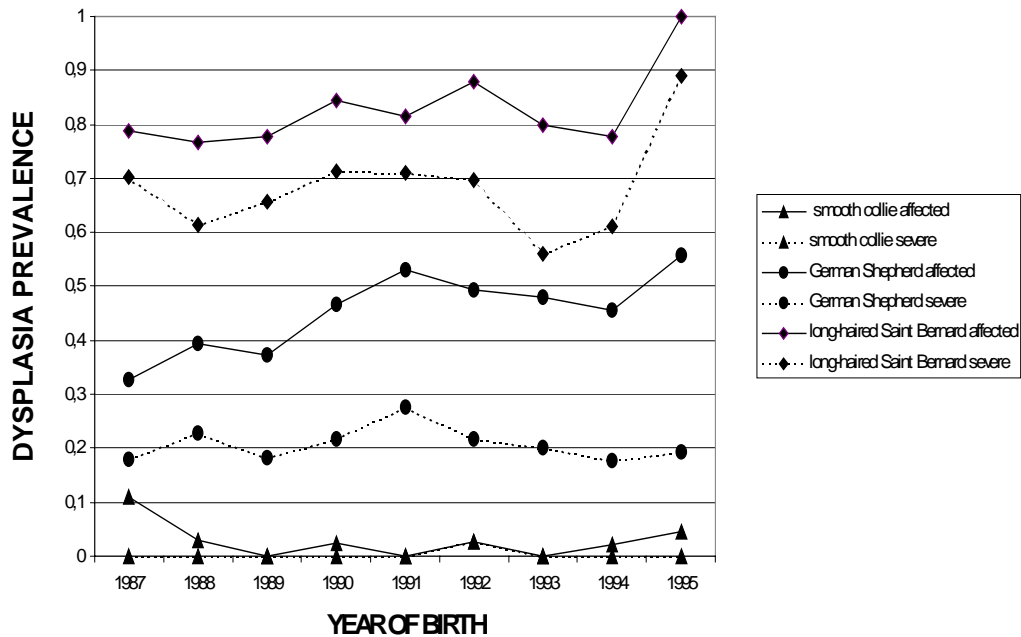
Because overall disease frequencies were low, the costs of finding affected animals were very high. In those breeds with high frequencies an increase in disease frequency was noticed. Thus, the present control programme has not been economically beneficial.

7.2.2. Hip dysplasia (V)

7.2.2.1. Disease frequency

A clear between-breed variation of dysplasia frequency was observed: from 2% (Smooth Collie) to 80% (Long-haired Saint Bernhard). In every breed, annual variations of frequency were noticed. Only in nine of the 22 breeds included in this study, were significant changes in hip dysplasia frequency detected. However in four breeds the disease frequency increased, and only in five breeds was a decrease noted. In other breeds the observed changes were so slight that they were thought to be caused by random variation. The frequency of severe HD in each breed followed very closely each breed's overall changes in HD frequency (Figure 5).

Figure 5. Overall hip dysplasia prevalence (straight line) and prevalence of severe hip dysplasia (broken line) according to the year of birth in smooth collie, German Shepherd and long-haired Saint Bernard in Finland. Year 1987 represents the prevalence of all animals in each breed screened before January 1, 1988.



7.2.2.2. Economic effectiveness

As already discussed in Chapter 7.4 numerous calculation models can be created for economic estimation. However, no benefit/cost -ratio over 1 could be shown for any breed or calculation model that were used. In some breeds dysplasia frequency had also increased during the study period, so in these breeds the benefit/cost -ratio was found to be negative. The best benefit/cost ratio (0.82) was achieved in the Nova Scotia Duck Tolling Retriever when calculation Model no 1 was used. This calculation model was the one which assumed the cost of hip dysplasia to be the highest. All calculation models have numerous sources of bias: especially the cost of treating hip dysplasia is very difficult to estimate.

7.3. HIP DYSPLASIA IN GERMAN SHEPHERD DOGS

7.3.1. Heritability (VI)

When the hip dysplasia scores from A to E were coded as numbers from 1 to 5, respectively, the mean value of the subjectively recorded hip dysplasia score was 2.42 with a standard deviation of 1.20. This corresponds average hip scorings between B (normal hips with slight changes) to C (mild dysplasia). The coefficient of the variation was 49.9%. The heritability estimates for hip dysplasia were moderate, varying from 0.31 to 0.35.

7.3.2. Environmental factors affecting hip dysplasia (VII)

Environmental effects: birth year and month, panelist, screening age of the dog as well as the effect of the genetic group of offspring from imported versus non-imported sires had significant effects on hip dysplasia. The litter and the breeder had only very small effects.

7.3.3. Phenotypic and genetic change and breeding values (V, VII)

No phenotypic progress could be shown, the disease prevalence had, instead, increased. As expected, also no clear genetic improvement could be shown in either males or females according to breeding value averages per year of births. Also, breeding values of parent animals were very similar to those of the whole population, which gives reason to suspect the effectiveness of selection.

8. DISCUSSION

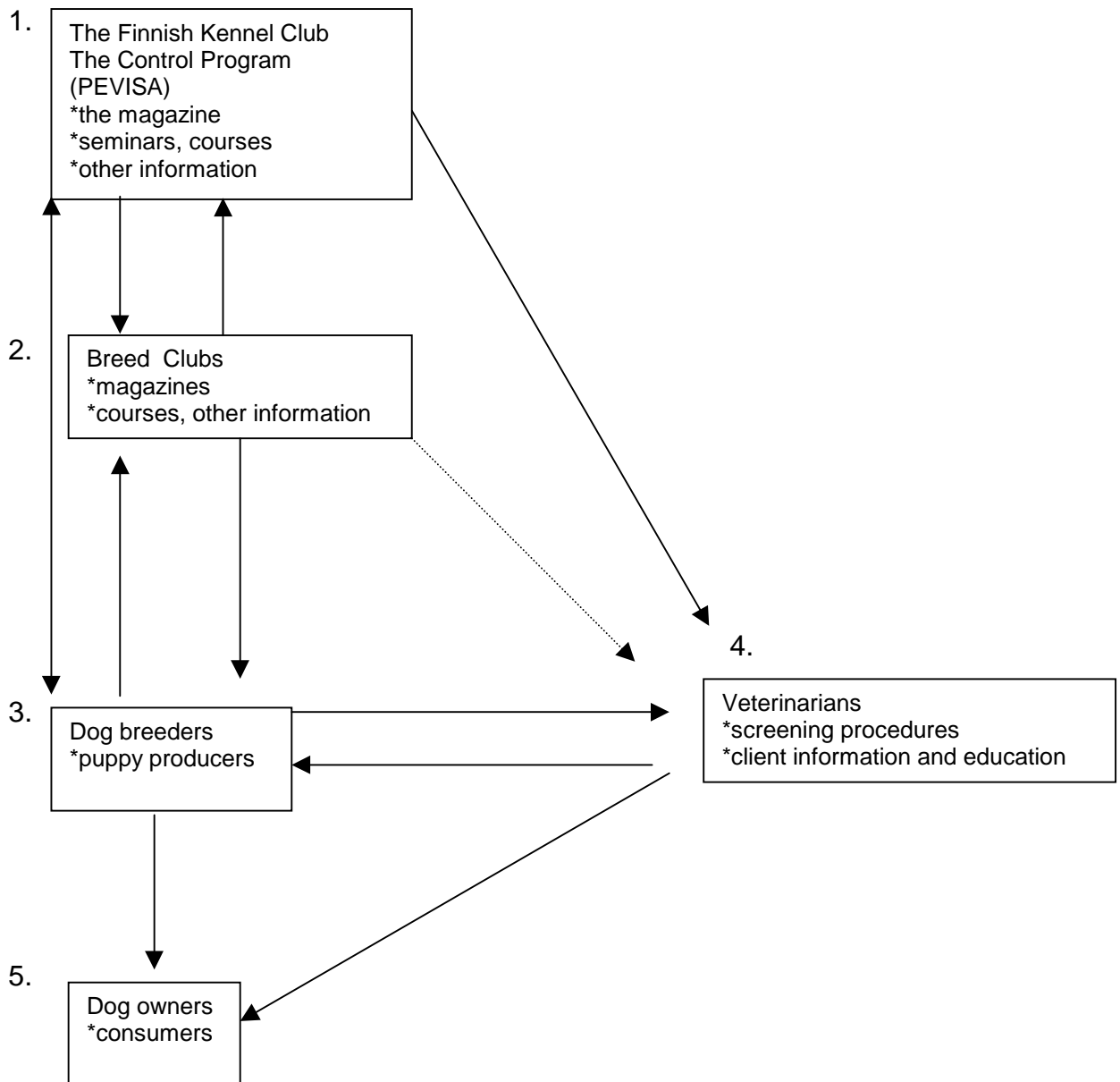
The FKC's PEVISA-programme has been ongoing for 15 years, but this work is the first scientific evaluation of its effectiveness. Because control programme for other diseases besides hip dysplasia and inherited ocular diseases has been ongoing only a few years and the number of dogs screened under the programme for these diseases is not yet very high, this study concentrated on hip dysplasia and inherited ocular diseases.

8.1. THE ROLE AND ATTITUDES OF DIFFERENT KEY GROUPS IN CANINE HEALTH PROGRAMMES

Because response rates in each surveys were moderate conclusions based on the findings in these surveys must be cautious. Veterinarians, breeders and owners with positive attitudes towards the programme might be more motivated to answer this type of surveys which might give a too-positive view of key groups' attitudes. Also it is socially acceptable to value health in dog breeding which might cause bias to responses. On the other hand, it can be assumed that people who have negative attitudes towards health programmes would have wanted to point out their opinions.

Veterinarians, dog breeders and dog owners are the three key groups in carrying out canine health programmes. Each of these groups has its own role. Expertise can refer to ability to perform tasks successfully, or to domain-specific knowledge that leads to differences in cognitive ability. These differences, then, may or may not lead to better decisions (Kuusela et al., 1998). Based on this definition of expertise,

Figure 6. Organization and roles of different groups in canine health control in Finland



veterinarians can be accepted as experts in canine health. Veterinarians are purely professionals and expert health service providers, whose customers are dog breeders and owners. Dog breeders have a more two-dimensional role. They function as customers in purchasing health information and services from veterinarians. On the other hand they are producers who sell their products to dog owners, and the breeders also provide the owners with

information about health-related issues. Dog owners as puppy purchasers or as receivers of health services and information have the role of consumers in canine health programmes (Figure 6).

Due to their professional education and background veterinarians should be able to get and use information about inherited diseases and their importance and further educate their customers about the issues, thus promoting positive health behaviour (Laing and Cotton, 1996). The main drawbacks in fulfilling their expert role are veterinarians' limited knowledge and difficulties of obtaining information about a given subject. Animal breeding and genetics have a minor share in the curriculum of veterinary education. Also veterinary literature and congresses are overflowing with information about the whole wide field of veterinary medicine, which makes it impossible to a veterinarian to keep up-to-date on every issue. The most current information about canine inherited diseases and control programmes is usually available in various dog magazines, at meetings of breed clubs' or the Kennel Club and in many cases as mouth-to-mouth information from breed fanciers. If a veterinarian is not personally involved with dogs and dog breeding, this information can be very difficult, if not almost impossible, to get.

In this study this problem was noted in the finding that veterinarians considered dog breeders to have better knowledge than they themselves, and also that breeders could be better experts in serving dog owners at present. On the other hand veterinarians had a positive attitude to improve their own role in serving customers and educating them, if only they themselves could get more information. For this purpose veterinarians should have their own easily accessible information sources that should be tailor-made to serve them. According to our study, the best media would be veterinary literature and courses, as well as the Kennel Club's direct information to veterinarians.

The possibilities of the Internet were not studied in this survey, but the Kennel Club's net pages directed to veterinarians would probably be a very useful medium. As experts veterinarians are more likely to look for new information; they are also better able to restrict their search to relevant and important information. Veterinarians should also be capable for more analytical classification of information than consumers, and they are less likely to misunderstand external information. As experts, they are more consistent with their decisions than less knowledgeable people (Alba and Hutchinson, 1987; Kuusela et al., 1998). If veterinarians continuously feel that their knowledge remains poor and the information they get is too limited, there is a risk that their present positive attitude to canine health programmes changes to negative, which then decreases the education and information veterinarians are able and willing to give to their customers. This in turn significantly decreases the possibilities of running effective health programme (Joos and Hickam, 1990; Rudd and Glanz, 1990; Downie et al., 1992).

As customers, dog breeders have to rely on veterinarians' ability to offer concrete health services, such as performing hip radiology or ophthalmological examinations (Bettencourt, 1997). It seems, that the veterinarians' role for many breeders is in performing the various procedures that breeders -- as experts -- consider important. In this study breeders estimated that veterinarians' knowledge is poorer than that of breeders and thus it could be expected that veterinarians could not inform and educate them very effectively. However, many breeders considered that veterinarians could be an effective information source to them in the future, which places pressure on the profession and continuing education. If breeders are considered as dog hobby professionals the findings that the Kennel Club and breed clubs are vital information sources to them is very logical.

Breeders are willing to adopt the role of experts. This was especially noticed in their attitudes toward dog owners: Breeders considered themselves to be the most important information sources together with breed club and the Kennel Club magazines. When we reflect on the fact that many breeders have been seriously working with their breed for years, it can be true that in many cases they also have gained a very high level of knowledge and expertise in their field. It is, however, also possible that many breeders have a long-time experience which leads to overly strong beliefs about one's true level of expertise and knowledge. This, in turn, can cause suboptimal decisions and actions also in health issues (Alba and Hutchinson, 1987). In such cases breeders may stop searching for information because they believe that no or only few new facts are available. This can lead to decisions that are based on outdated or erroneous information.

Breeders' positive attitude to health programmes have two possible reasons. For the most dog breeders in Finland, owning and breeding dogs is a hobby which can be very ambitious and professional, but not commercially motivated. Thus dogs are considered more as family members whose health and well-being are as important as that of any other family members. For more commercially-orientated breeders, health control can be one method to improve the quality of their merchandise and their reputation as breeders and thus be able to fetch better prices. On the other hand for some breeders, health screening and especially fear of negative findings can be a threat to their reputation.

For most dog owners a pet is an important member of the family and thus entitled to have the same services and well-being as other family members (Hirschman, 1994; Allen, 1997; Beaver, 1997). According to the WHO definition (1946) well-being is the positive aspect of health. Well-being is often

a very subjective idea based on a person's feelings and emotions. Subjective well-being may differ from true well-being which reflects an individual's positive health (Downie et al., 1992). Thus it is obvious that most dog-owners have high demands for and positive attitudes toward effective canine health programmes, which as "health promotion" have positive effect on dogs' health in their own environment (Green and Raeburn, 1988; Stachtchenko and Jenisek, 1990) Also in those cases in which a dog is more a working aid -- for example hunting or other working dogs -- good health is important so that the tool can function without any problems.

An average dog owner has very clearly the role of a consumer of different services or product providers: Dog breeders market their products -- puppies - - and also have good possibilities to educate future dog owners about health issues and programmes. A consumer's decision is seldom independent, but instead at least recommendation-based or even purely dependent or subcontracted. Consumers often rely on recommendations either from strong-tie sources, such as family, friends or other socially "close" persons, or weak-tie sources, such as professionals or experts , who are not limited to the consumer's own social circle (Duhan et al., 1997). Thus consumers' decision-making and choices, even in health-related issues, can be affected through education and advertising (Elliot, 1998). A breeder's positive attitude together with accurate and understandable information can have a significant effect in motivating dog owners to participate in health programmes. Also, in most cases dog owners consider veterinarians as experts who have many opportunities to meet dog owners during routine veterinary visits, and in discussions and appropriate client communications they affect dog owners' decisions. Dog owners as customers, however, can also affect the quality of the service they get and also share their positive experiences with other consumers (Bettencourt, 1997). If breeders and veterinarians have gained

reliability and prestige and are able to give information that is understandable and meaningful to dog owners, they can have tremendous opportunities to affect the way dog-owners care for their animals (Joos and Hickam, 1990; Downie et al., 1992). The importance of these two close-contact information sources was also found in the present study. It was beyond the scope of this study to find out how consumers react if these close-contact sources have discrepancies in their attitudes and in the information they give to consumers.

All surveys considered the Kennel Club and breed club magazines to be important. In reality, however their effectiveness is probably lower, because according to this study about 25% of dog owners were not the Kennel Club members and almost 40% of dog owners in our study were not members of their breed clubs. If this is true, a significant proportion of dog-owners cannot be reached with the information in the Kennel Club or breed clubs magazines.

8.2. SUCCESSES AND SHORTCOMINGS OF THE FINNISH KENNEL CLUB'S CANINE HEALTH PROGRAMME (PEVISA)

According to our studies the control programme has succeeded in significantly decreasing hip dysplasia prevalence in only 5 of the 22 breeds. Also, in most breeds currently in the control programme, the frequency of inherited ocular diseases is very low, and improvement with the control programme is hard to achieve. In addition, those breeds with significant frequencies of inherited ocular diseases are even showing an increase in disease frequency in spite of the programme. On the other hand, I believe that the situation could be even worse without the PEVISA programmes. Because of the programme, dogs with preliminary diagnosis of inherited diseases in the programme may not be officially tested and are therefore excluded from breeding anyway. Even though a significant decrease in HD frequency could not be shown in most

study breeds, it is possible that some degree of clinical improvement is happened also in these breeds. Without more clinical studies this improvement is hard to show.

Economically, screening has been very expensive and no benefits can be shown. Measuring economic benefits, however, is extremely difficult: Is it adequate to calculate only the decrease in the number of affected animals (Swenson et al., 1997A) or should we also estimate the costs of treating affecting animals? It is impossible to reliably estimate these costs without wide clinical studies, as it is very difficult to predict whether a dog will clinically suffer from its disease (Barr et al., 1987; Banfield et al., 1996). In addition to estimating clinical disease, losses in breeding values or in decreased quality of life cannot be accurately estimated. Also, between-breed variation should be noted in economical evaluation. Finally, measuring psychological and social well-being of a pet and an owner in a cost-effective way is impossible.

It can be asked, if owners should be responsible for expenses of the programme, like in most cases happens at present. Emotional and social well-being that owners get when they offer positive health action to their pet may not be enough to motivate the owners to pay for screening of their healthy pets. Owners might feel that participation in a programme can increase their pet's quality of life -- especially if screening enables early recognition of certain diseases and effective treatment or preventive measures after it. However, in many cases eliminating an affected animal from the breeding pool or from the population, may be good for the population (here a breed), but may not be particularly beneficial for the individual animal or its owner. The information from screening in most cases is more beneficial to breeders and breed clubs. Suggestions that breeders should participate more in

expenses have been made for example by the present president of the Finnish Kennel Club, (Eerola, 2000). At present, some breeders even do so.

The main success of the FKC's health programme is that the key groups -- veterinarians, dog breeders and dog owners -- share a positive attitude to it and also believe its effectiveness, thus giving reason to believe in their motivation to continue to participate the programme in the future. When analyzing the concrete results of the control programme, negative criticism and target groups' increasing lack of motivation are, however, understandable. In present studies registration limitations and obligatory health screening were those health -related activities that were believed to have been the most effective in improving canine health so far. Behaviour change or maintenance can be achieved by experimental learning experiences or through legislation (Beitz, 1998). However, legislation can achieve its maximum effectiveness only if it supports target groups' previous attitudes and behaviour (Downie et al., 1992). In the future, education directed to all key groups from suitable sources was considered to be even more effective in affecting health-related behaviour and improving canine health.

There are several explanations for the ineffectiveness of the programme: Selection against hip dysplasia, which is a quantitatively inherited trait with moderate heritability, cannot be expected to be very effective when selection is based only on phenotypic observations, as is done in the present system. Also, as all breeders' compliance and commitment to programmes is not always high, other selection criteria in breeding are thought to be more important. The lack of commitment and the importance of other selection criteria were shown in the study of German Shepherds (Study VII), which showed an increase in selecting breeding animals whose hip status was not excellent. This found lack of commitment is contradictory to the breeders

positive attitude to health and health screening found in the breeder survey (Study II). This strengthens the suspicions for social bias in survey results.

The increase in CEA frequency in collies and PHTVL frequency in Dobermanns in Study IV can be explained by the changes in screening routines. However, if breeders and dog owners are not aware of this, they may lose their faith in the usefulness of the programme and its achievements. The biggest problem in ophthalmological screening is that current diagnostic methods are not able to detect many disorders until the dog is middle-aged or old, which decreases the efficiency of screening. In addition, for most breeds there is currently no method to detect carrier animals, that could give the possibility to exclude them from breeding and thus reduce within-breed disease gene frequencies.

Although the initiative to include a breed in the current PEVISA-programme has to come from the breed club itself, the current programme is not very flexible and does not generally accept individual breed-specific variations. In addition, within many breed clubs there are different opinions and disagreements between breeders and other active members concerning a breed's health status and key points of breeding. The ongoing debate for and against current health programme has been very active in many breed clubs, in the FKC and in their publications, but based more on personal opinions with no scientific backup (Paatsama, 1998; Yrjölä 1998; Hirvensalo, 1999; Eerola, 2000). In most cases the goals and objectives of the health programme are not clearly defined and people's expectations of what, how and when should be achieved with the programme are variable. Thus objective evaluation of a programme is difficult and different people may have different perceptions of the success or failure of a control programme.

8.3. POSSIBILITIES TO IMPROVE THE CANINE HEALTH PROGRAMME (PEVISA)

The present control programme concentrates more on collecting information, but the information is not effectively used in improving individual breeding programmes. The present data format that is used in the FKC is very difficult and time-consuming to convert to be suitable for most common statistical and calculation programmes. For breeding of quantitative traits, for example hip or elbow dysplasia or many working abilities, predicted breeding values based on testing records would probably give better results than present phenotypic selection method. Studies VI and VII as well as some others (Karjalainen et al., 1996; Liinamo et al., 1997; Mäki, 1998) showed that the present collected information available from the FKC or from many breed clubs, either about diseases or working abilities, is adequate and suitable for that purpose.

Development of advanced diagnostic methods can improve the control and breeding against inherited ocular diseases. Recent studies of the ERG technique have shown that this method is not only capable of detecting PRA-affected animals much earlier than an ophthalmological examination, but it also has the potential to detect carrier animals (Kommonen et al., 1997). The ERG method, however, is quite complicated and time-consuming, which limits its clinical usefulness. The enormously rapid development of DNA techniques offers the most hope. It is already possible to identify Irish Setters that are PRA carriers, and with advanced research, DNA tests for other breeds and gene defects will probably be commercially available in the near future (Binns, 1997; Petersen-Jones, 1998).

Advanced education of key groups --veterinarians, dog breeders and dog owners-- about health issues and control programmes should be more

focused in the future. This is the only way to improve experts' current knowledge and skills and to educate the consumers so that all key groups have clear ideas about the goals of the health programme. All key groups should also be well-educated about available methods -- and their limitations - - that can be used in reaching those goals. With advanced learning and understanding the final goals of the programme all key groups should have strong and long-lasting motivation to participate in the programme in spite of temporary drawbacks (Beitz, 1998).

A final method to improve the current health programme is better co-operation of all key groups in programme planning and evaluation. Ideally, each breed should have its own breeding programme that is created in co-operation with breeders, owners, the breed club and the FKC. This programme should integrate a breed's overall health situation, other key issues in breeding and necessary breed-specific health screenings with appropriate preventive measures (Rubin, 1989; Downie et al., 1992). In creating a breed-specific programme, not only the knowledge of the breeders, but also advanced use of expertise within animal breeding and veterinary profession should be used. Also the attitudes and expectations of consumers --that is the dog owners -- should be taken in the consideration in defining the goals and objectives of a programme. More advanced evaluation of the current programme and performing necessary changes according to the results of the evaluation is needed. As was shown in this study, key groups' positive attitude alone is not adequate, effective selection and breeding programmes are also needed for good results.

9. CONCLUSIONS

Corresponding to the aims of the study, the following final conclusions can be drawn:

1. Respondents from all key groups -- veterinarians, dog breeders and dog owners -- in canine health programme share a positive attitude to programmes and are well motivated to participate in them. However, lack of knowledge and limited effectiveness of different information sources can decrease their motivation and limit their ability to understand the importance, goals and possibilities of health programmes. Especially dog breeders and owners considered inherited diseases to have a major effect on canine well-being, veterinarians -- supposedly because of their broader clinical experience -- find other diseases to have more importance.

2. Current health programme was not able to show clear economic benefits in dog breeding, and its effectiveness in disease prevention has also been very limited. On the other hand indirect economic or health benefits in the form of better performance or well-being are difficult to measure. Also, it is impossible to estimate what the situation would be without the programme. The most important drawbacks of the current programme are the lack of individual within-breed modifications and efficient programme evaluation. The programme is focused in collecting information, but advanced and effective use of this information in breeding programme is lacking. The present data management system of the FKC is very difficult and laborous to convert to formats that are easily used for statistical analyses.

3. In order to reach the full potential of the health programme it should be breed-specific with clearly defined goals and objectives. All key groups should

participate in planning and evaluation. The most advanced methods in veterinary medicine and animal breeding -- such as predicted breeding values and DNA-techniques -- should be used.

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