

Thai Twin Registry: Description of the Initial Stage

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The present study describes the initial phase of the Thai Twin Registry (TTR) in Khon Kaen University, a pioneer research university located in the Northeast of Thailand. The initial steps of the study included the analysis of dermatoglyphic information in Thai twins for answering the research question: Are monozygotic (MZ) and dizygotic (DZ) twins different in dermatoglyphic variables? Subjects were 212 twin pairs (81 MZ and 131 DZ), consisting of 155 males and 269 females. Four types of fingerprint pattern (FP) — that is, arch, radial loop, ulnar loop, and whorl — were classified and analyzed and compared between MZ and DZ twins. The arch radial loop and whorl frequencies differ between MZ and DZ twins. When comparing FP in each finger, only the right little finger shows a statistically different FP, while the FP similarity average from 10 homologous fingers of co-twins was greater in MZ than DZ twins. By using the Area Under the Receiver Operating Characteristic curve analysis, the MZ twins could be differentiated from DZ twins by the FP similarity. Summarizing, this valuable report about TTR was conducted by analysis of FP data, which indicated that the MZ and DZ twins exhibited FP pattern and FP similarity differences. Other dermatoglyphic studies of the existing FP database, such as finger ridge count, finger ridge density, and minutia, will be considered for ongoing research at the TTR.

■ **Keywords:** Twin registry, fingerprint pattern, similarity, zygosity, Receiver Operating Characteristic, Thailand

The population of Thailand is nearly 64 million (Ministry of Public Health Thailand, 2010). The most populated region is the North-Eastern region, which has a population of approximately 33.8% of the total Thai population. Khon Kaen University (KKU), one of the national research universities of Thailand, is located in Khon Kaen province, which is a major center in the Northeast. Although a twin registry has not been established in KKU, a few studies of Thai twins have been performed with a forensic science purpose. Consequently, a database of palm prints and fingerprints of those twin subjects is available. Twins are of special interest for genetic studies due to their genetic similarity. Fingerprint pattern (FP) inheritance is under the control of at least seven different genes (Slatis et al., 1976) coupled with an embryonic environmental factor (Penrose & Ohara, 1973). The Thai Twin Registry (TTR) has been established in KKU. Starting with fingerprint research using an existing Thai twin dermatoglyphic database, interesting questions have been raised such as: (1) Are monozygotic (MZ) twins more similar than dizygotic (DZ) twins in dermatoglyphic variables? (2) To what extent do genetic and environmental factors influence dermatoglyphic variables in the Thai population? The present study summarizes how

to obtain dermatoglyphic data and the results of dermatoglyphic analyses, and some of those research questions are explored as well.

Aims of the TTR

The ultimate goal of the TTR is to establish a database of Thai twin pairs in which socio-economic information and biological specimens are included. As an initial step, we are currently collecting dermatoglyphic information of palm prints and fingerprints to analyze differences of FP similarities within MZ and DZ twin pairs. Moreover, a selected cutoff point of the FP similarity with same-sex twins is investigated to determine the MZ or the DZ by using the Receiver Operator Characteristic (ROC) and the area under the curve (AUC) analysis (Murphy et al. 1987).

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The Database of Possible Twins

It appears that no research has been conducted using twin registries in Thailand. However, the National Science Center for Education, Ministry of Education (<http://www.sciplanet.org>) held a 'Twin Meeting Day' in 2007. A database of that twins' meeting is not publicly available. There are three sources of information on possible twins: (1) hospitals, (2) the civilian Registrar's Office of each province, and (3) the schools in municipalities and rural areas. Hospitals at the provincial level are the best source for twin birth registrations. While the municipality and the district Civilian Registrar Offices possess birth date and home addresses of twins, schools are one of the best sources of school-aged twins.

Location and Recruitment of the Twin Subjects

Recruitment of twins has been performed using three methods. First, official letters from KKU were distributed to the headmasters of primary and junior high schools for cooperation in developing a twin registry. The second method is called a snowball technique: a friendly talk with schoolteachers or twin subjects has led to recruitment of other eligible twins they knew. The third method, publicity via television news, identified schools in which several twin pairs studied. In total, one province (Suphanburi) in the central region and seven provinces (Khon Kaen, Nakhon-ratchasima, Chaiyaphum, Surin, Sakon Nakhon, Kalasin, and Mahasarakham) located in the Northeast were selected for recruitment of the TTR.

Ethical Issues

The research protocol titled 'Dermatoglyphic study of Thai twins' was reviewed and approved by Khon Kaen University Ethics Committee for Human Research (HE532334; IRB00001189; FWA00003418).

Data Collection Procedure

Twin subjects recruited from primary and junior high schools and villages were asked to participate in palm and fingerprinting. In total, 212 twin pairs (155 male, 269 female), aged between 6 to 66 years were informed and gave consent for printing their 10 fingertips and palm prints using a transparent adhesive tape technique (O'Leary et al., 1986).

Zygoty Determination

The twin subjects were classified into two types, MZ and DZ twins, using two criteria: the biological facts (ABO blood type and sex), and the zygoty questionnaire (Song et al., 2010). The zygoty questionnaire for physical characteristics was modified to fit the Thai culture. Each twin pair was

checked whether they were the same sex and same ABO blood type, as well as two items of 'yes' responses from the four physical characteristics questions, or else zygoty information determined as MZ twins by a medical doctor, resulting in classification of MZ twins. For the DZ twins determination, same sex but different ABO blood type or differences in sex and ABO blood type, as well as 'no' responses to the four physical characteristics questions or zygoty determined as fraternal twins by a medical doctor, were checked.

Database Available

An availability of dermatoglyphic (palm and fingerprints) database of 212 twin pairs was made possible, as it had been kept both in hard copies and digital files by the authors at KKU, Thailand.

Summary of Recent Research

The fingerprint pattern (FP) types were identified by the first author and then classified into four types, that is, arch (A), radial loop (RL), ulnar loop (UL), and whorl (W). The FP similarity for 10 homologous fingers was assessed by matching the same FP type on the homologous fingers between the DZ and the MZ twins. A value of 1 means there was only one homologous finger possessing the same FP type. Thus, the maximal FP similarity was 10, while zero was the minimal value of FP similarity.

The 81 pairs of DZ twin (162 persons) and 131 MZ twin pairs (262 persons) were classified based on the mentioned criteria. The FP frequency and the FP similarity scores were analyzed by DZ and MZ twins to see the magnitude of significant differences between them.

FP Frequency

Frequencies of four FP types by fingers were analyzed comparing DZ and MZ. This revealed that only the right little finger had FP significant difference (LR $\chi^2_{(3)} = 10.14$, $p = .017$). The A and RL were found as 1.2% and 3.1% for the DZ twins while 0.8% and none for the MZ twins; W was found 24.1% for the DZ twins compared to 26.7% for the MZ twins.

FP Similarity

The MZ twin pairs had an average score of FP similarity of 10 homologous fingers significantly greater than that of the DZ twin, 7.82 ($SD = 1.56$) vs. 6.43 (2.01).

ROC and AUC Analysis for Twin Differentiation

In medical research, the AUC is commonly used as a statistic calculated on the observed disease scale and is a measure of an efficiency of phenotype prediction using a test classifier (Wray et al., 2010). For TTR, the ROC was obtained by

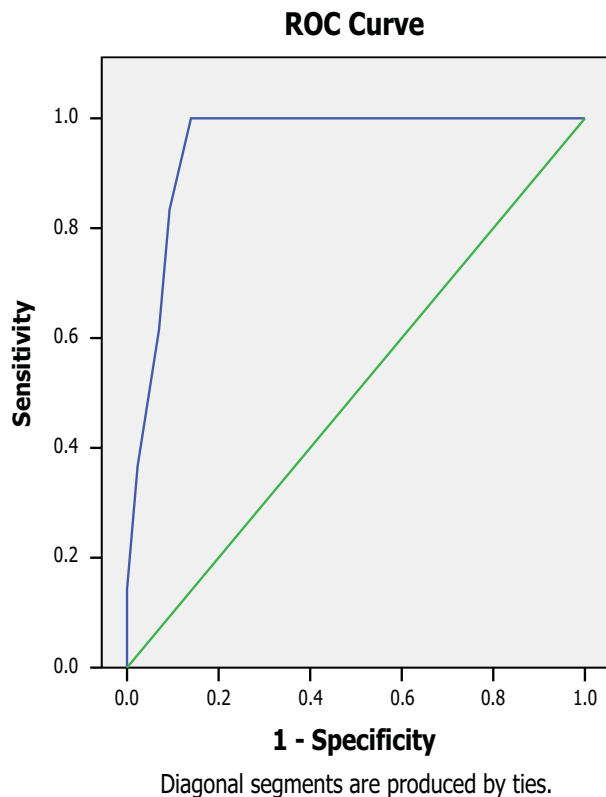


FIGURE 1
(Colour online) The ROC curve for the FP similarity.

plotting sensitivities against one minus specificities using the cutoff point of FP similarity of 6 to differentiate the MZ twins from the DZ twins. The AUC was constructed by an SPSS for Windows (version 17). It yielded an AUC of 0.949 (95% CI = 0.901–0.906) indicating a high efficiency for discriminating the MZ twins from the DZ twins (see Figure 1).

Conclusion

This is considered to be a valuable study in the collection and analysis of palm and fingerprint analyses of a significant number of twins, both MZ and DZ twins of the Thai people.

As indicated, this is part of ongoing research at the TTR using palm and fingerprint analyses, and is part of the process of developing a Thai twin database at Khon Kaen University, a major government university in northeastern Thailand. The researchers are considered to be a significant authority on this topic in Thailand.

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